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NAGY (B.), REICHART (G.) & UBRIZSY (G.). **Amerikai fehér szövőlepke** (*Hyphantria cunea* **Drury**) **Magyarországon.** [*H. cunea* in Hungary.] —*Növényvéd. Kut. Int. Kiadv.* pt. 1, 70 [+1] pp., 31 pls., 8 figs., 5½ pp. refs. Budapest, 1953. (With Summaries in Russian and German, 26 pp.)

The following is based on the authors' summary. Since its discovery near Budapest in 1940 [*R.A.E.*, A **36** 254], *Hyphantria cunea* (Dru.) has spread throughout Hungary and into Czechoslovakia [**40** 52], Yugoslavia [**41** 297], Austria [**40** 376] and Rumania, chiefly along transport routes [*cf.* **40** 52]. All stages of this Arctiid are described, and an account is given of observations on its bionomics in Hungary [*cf.* **38** 162], which closely resemble those recorded from Austria [*cf.* **41** 61]. Adults were present in April–May and July–August, and though most of the second-generation pupae hibernated, some gave rise to a partial third generation, which died in the larval or prepupal stage. The percentage of second-generation pupae that gave rise to adults in the same year was 10–36 in 1950. Mortality was 22·9–39·8 per cent. among the overwintering pupae in 1949–50 and only 0·2–14·9 per cent. among the first-generation pupae in 1951. Of the latter, 1·14 per cent. entered a diapause that lasted for up to nearly a year, the last adult emerging in the following June. The number of eggs laid per female was about 500 in spring and 800 in summer, but varied with the plant on which the female had developed, averaging 953 on mulberry and 563 on walnut in the summer of 1950; the highest observed was 1,312. The eggs hatched in 7–10 days in the field, and in 16–23 days at 18°C. [64·4°F.] and below. The duration of development also depended on the food-plant. Larvae reared on apple leaves became full-fed in 56·5, 33·5 and 24 days at 20, 25 and 30°C. [68, 77 and 86°F.], respectively, and the pupal stage lasted 7–13 days under normal conditions and 8–22 days at the end of the summer. Dry sites are preferred for pupation, but pupae have not been observed in the soil in Hungary. Of the adults, 13–47 per cent. of the overwintered generation and 0·2–1·8 per cent. of the summer generation were of the spotted form (typical *cunea*) [*cf.* **38** 162]. The numerous food-plants of the moth are reviewed and are stated to number 103 species in Hungary and 203 in the whole of central Europe [*cf.* **41** 60]. Apart from forest trees, those chiefly threatened in Hungary include mulberry, walnut, cherry, apple and plum.

Infestation has been greatly reduced by control measures, including spraying with emulsified solutions of 0·8–1 per cent. DDT, and tying straw, which is subsequently burnt, round the stems of trees to trap full-fed larvae seeking pupation sites. The need to avoid the planting of primary food-plants of the moth in afforestation areas and shelter belts is emphasised. Among the numerous parasites reared from the pupae, *Psychophagus omnivorus* (Wlk.), which afforded 8–10 per cent. parasitism, was the most important. In the laboratory, the females of this Pteromalid oviposited in an average of 13·7 pupae each, and 20 adult parasites emerged from each pupa. Other pupal parasites were the Torymids, *Monodontomerus aereus* Wlk. and *M. virens* Thoms., and the Pteromalid, *Dibrachys cavus* (Wlk.), which were occasionally hyperparasitic, and the Ichneumonids, *Pimpla instigator* (F.), *P. turionellae* (L.) (*examinator* (F.)) and *Theronia atalantae* (Poda). The larvae were parasitised by *Tachina larvarum* (L.), which gave up to 62 per cent. parasitism, *Tachina* sp., *T. fallax* Mg., *Pales pavida* (Mg.) and *Compsilura concinnata* (Mg.), and were preyed on by *Auriga* (*Arma*) *custos* (F.), *Polistes gallicus* (L.) and *Chrysopa vulgaris* Schneider, *Chrysopa* sp., and various birds. The only egg parasite observed was *Trichogramma evanescens* Westw., which was of no importance.

COSTANTINO (G.). **I principali insetti parassiti dell'olivo e degli agrumi ed i mezzi di lotta artificiale, con particolare riguardo ai prodotti organici di sintesi.** [The principal Insect Pests of Olive and *Citrus* and Means of Control, with particular Reference to synthetic organic Products.]—*Notiz. Mal. Piante* no. 31–32 (N.S. no. 10–11) pp. 131–161, 48 refs. Pavia, 1955.

Of the 42 species of insects recorded as attacking olive in Italy, only seven are common and injurious [*cf. R.A.E.*, A **43** 373]. They comprise *Liothrips oleae* (Costa), *Saissetia* (*Coccus*) *oleae* (Bern.), *Pollinia pollini* (Costa), *Prays oleellus* (F.), *Phloeotribus scarabaeoides* (Bern.), *Rhynchites ruber* Fairm., and *Dacus oleae* (Gmel.), and notes are given, largely from the literature, on their distribution, bionomics and control, especially by means of organic insecticides.

Of the 34 recorded from *Citrus* in Italy, 15 are injurious, and notes are given on their food-plants, bionomics and control, including in some cases natural enemies. They comprise the Coccids, *Icerya* (*Pericerya*) *purchasi* Mask., *Planococcus* (*Pseudococcus*) *citri* (Risso), *Coccus hesperidum* L., *Saissetia oleae*, *Ceroplastes sinensis* Del G., *Lepidosaphes* (*Mytilococcus*) *beckii* (Newm.), *L.* (*M.*) *gloverii* (Pack.), *Parlatoria ziziphus* (Lucas), *P. pergandii* Comst., *Aspidiotus hederae* (Vall.), *Chrysomphalus dictyospermi* (Morg.) and *Aonidiella aurantii* (Mask.), *Prays citri* (Millière), *Ceratitis capitata* (Wied.), and the ant, *Tapinoma erraticum nigerrimum* (Nyl.) [*cf.* **21** 524]. *Iridomyrmex humilis* (Mayr) is a pest in the *Citrus* groves because it fosters Coccids and other honeydew-producing insects.

AIAZZI-MANCINI (M.) & PEPEU (G.). **Studio tossicologico del parathion presente nell'olio di oliva di uso alimentare. Rassegna critica e ricerche sperimentali.** [A toxicological Study of the Parathion present in edible Olive Oil. Critical Review and experimental Research.]—*Arch. ital. Sci. farmacol.* (3) **5** repr. 19 pp., 1 graph, 71 refs. Milan, 1955. (With Summaries in English, French and German.)

The authors review the toxicology of parathion, with particular reference to its anti-cholinesterase activity, and describe experiments carried out in Italy to determine whether the parathion residues in the oil from olives sprayed with this insecticide for the control of *Dacus oleae* (Gmel.), which were found to range from 4 to 24·9 parts per million [*cf. R.A.E.*, A **43** 376], constitute a danger to consumers.

In an experiment with male and female rats, the median lethal dosages of parathion administered orally were found to be 17 and 4 mg. per kg. body weight, respectively, in olive oil, and 17 and 5 mg. in propylene glycol. Symptoms appeared in 2–4 hours with either solvent. When 1 cc. olive oil containing 19 p.p.m. parathion was injected into guineapigs intraperitoneally and intramuscularly each day for 42 days, so that each animal received a total of 3 mg. parathion per kg. body weight, their condition remained unaltered, and there were no changes in the esterase activity of the heart blood during or at the conclusion of the test.

More detailed experiments were carried out with dogs. In puppies with an initial weight of 2·15–3·25 kg., growth and esterase activity of the blood were all normal following daily oral administration of doses increasing from 3 to 15 cc. olive oil containing 24·9 p.p.m. parathion, continued for six months when a total of 27 mg. parathion had been administered per animal, and similar results were obtained when two dogs weighing 6·7 and 7·5 kg. received daily doses, for 80 days, of 25 cc. olive oil to which 25 p.p.m. technical parathion had been added. In a further test, esterase activity of the liver and brain was normal after daily administration to dogs and puppies,

continued for six months, of 25 cc. oil containing a residue of 7·8 p.p.m. parathion, or of 25 cc. oil to which 9·2 p.p.m. parathion had been added, the animals receiving totals of 32 and 40 mg. parathion, respectively. The effects of acute parathion poisoning were then examined in dogs that ingested 5–8 mg. parathion per kg. body weight in oil; 5 mg. did not inhibit true esterase activity but reduced pseudoesterase activity by 60–70 per cent. in the first few hours, and 7–8 mg. reduced true esterase activity to 30–40 per cent. of its initial value in a few hours and pseudoesterase activity to 10–20 per cent. One of the two dogs that received the 8-mg. dosage died as a result on the second day. Negligible amounts of p-nitrophenol were found in the urine of the dogs used in the first tests, and it is concluded that hydrolysis was rapid; more was eliminated by those in the last test, the proportion of the parathion administered that it represented being highest for the 5-mg. dosage and lowest for 8 mg., and most of it was eliminated on the first day.

Smith (K. M.) & Lauffer (M. A.). Ed. **Advances in Virus Research. Volume I.**—9¼ × 6 ins., xi + 362 pp., 28 figs., many refs. New York, N. Y., Academic Press Inc.; London, Academic Books, Ltd., 1953. Price $8.

The results of research on viruses are published in the literature of many different branches of science, and even review articles are widely scattered. The information is therefore to be co-ordinated in a series of volumes, of which this is the first, each containing critical review articles on different aspects of virus research, but excluding any purely descriptive of new virus diseases, written by various authors who are to incorporate their own views. The present volume comprises eight such reviews dealing with viruses that affect man, animals, insects, plants and bacteria. Three are of entomological interest. One, by C. W. Bennett (pp. 39–67, 69 refs.), on the interactions between viruses and virus strains, contains accounts of the transmission of the virus complex responsible for the rosette disease of tobacco by *Myzus persicae* (Sulz.) [*cf. R.A.E.*, A **34** 70] and the interactions between the virus strains that cause the swollen-shoot disease of cacao in West Africa and are transmitted by *Pseudococcus njalensis* Laing [*cf.* **44** 48, etc.]. Another, by L. M. Black (pp. 69–89, 87 refs.), on the transmission of plant viruses by Cicadellids, includes information on the processes of transmission, the relations between the viruses and their vectors, the incubation and multiplication of the virus within the vector [*cf.* **29** 502], the four known plant viruses transmitted through the eggs of their vectors [*cf.* **22** 59; **39** 323; **43** 266], strains of vector species differing in their ability to transmit [*cf.* **20** 717; **29** 500], the effect of ecological conditions on vector and virus and plant resistance to infection. A third, by G. H. Bergold (pp. 91–139, 7 figs., 160 refs.), on viruses that attack insects, contains accounts of the pathology of polyhedral and capsule diseases [*cf.* **44** 31], the classification, nomenclature and morphology of the viruses, the physical properties and chemical composition of the viruses and their associated inclusion-body proteins, the nature of the inclusion bodies, the multiplication of the viruses within their hosts, the infectivity of the viruses, and methods of transmission.

Fernald (H. T.) & Shepard (H. H.). **Applied Entomology. An introductory Textbook of Insects in their Relations to Man.**—5th edn., 9½ × 6¼ ins., ix + 385 pp., frontis., 270 figs., refs. New York, N.Y., McGraw-Hill Book Co., Inc., 1955. Price $7 or £2 12*s*. 6*d*.

This fifth edition of a work already noticed [*cf. R.A.E.*, A **31** 433, etc.] has been brought up to date by numerous text alterations. The section

dealing with insecticides (pp. 44–59) has had to be completely rewritten, as the fourth edition appeared in 1942, and the examples adduced in the systematic chapters are essentially species that are at present of economic importance in the United States. A selected bibliography is appended to each chapter.

Lozina-Lozinskiĭ (L. K.). **The Rôle of Nutrition in the Development and Reproduction of the Cotton Noctuid** (*Chloridea obsoleta* **Fabr.**). [*In Russian.*]—*Trud. vsesoyuz. ent. Obshch.* **44** pp. 3–61, 5 graphs, 52 refs. Moscow, 1954.

Heliothis armigera (Hb.) (*Chloridea obsoleta*, auct.), which is polyphagous, is an important pest of cotton in Soviet Azerbaijan, and detailed investigations were carried out in the field and laboratory there in 1937–40 on the nutrition of the larvae and adults and its effect on survival and reproduction, the main results of which have been noticed from a preliminary account [*R.A.E.*, A **29** 235]. Emergence from the overwintered pupae in Azerbaijan begins about 20th April and reaches its peak between 10th and 15th May, but cotton is not infested until June, the first generation developing on other plants. Of these, the chief cultivated plant is chick pea (*Cicer arietinum*), which is extensively grown and frequently sown close to cotton as a trap-crop, and the main wild plants are *Datura stramonium*, *Hyoscyamus niger*, *Abutilon avicennae* and *Solanum nigrum*, on which oviposition is intense, and it is shown that the size of the second generation, on cotton, is dependent on the nutritional conditions provided by these for the first generation in any given year. Control can best be effected by destruction of wild food-plants in spring.

Rubtsov (I. A.). **Natural Enemies of Soft Scales and Cushion Scales in the Fauna of the USSR and Problems of their Use.** [*In Russian.*]—*Trud. vsesoyuz. ent. Obshch.* **44** pp. 202–239, 18 figs., 51 refs. Moscow, 1954.

Pulvinaria aurantii Ckll. is an important pest of *Citrus* on the Black Sea coast of the Caucasus, and *P. floccifera* (Westw.) infests *Citrus*, tea and other subtropical evergreen plants in various districts in the south of the Soviet Union. Little was known of their natural enemies, but observations in infested areas have shown that certain species of *Pulvinaria* and the closely related *Filippia viburni* (Sign.), which infests *Viburnum* and other ornamental plants, are attacked locally by parasites and predators, some of which are of considerable importance. A list of them is given, followed by notes on the distribution, effectiveness and hosts of the important ones, descriptions of those not previously described in Russian, and information on the bionomics of some based on the literature and on investigations in 1949–51 in a botanical garden in the Crimea. The most effective species comprise *Encyrtus masii* (Silv.), which parasitises *F. viburni* and *P. floccifera*, *Leucopis silesiaca* Egg. and a species close to *L. alticeps* Czerny, which destroy the eggs in the egg sacs of *F. viburni*, *P. floccifera* and *P. pistaciae* Bodenh. (on *Pistacia*), all in the Crimea, and *Blastothrix sericea* (Dalm.), which parasitises *P. betulae* (L.) (on vines), and *Hyperaspis campestris* (Hbst.), which feeds on the eggs of *P. floccifera*, *P. aurantii* and *Coccus pseudomagnoliarum* (Kuw.) on *Citrus*, both on the Black Sea coast of the Caucasus. Suggestions are made for introducing these into areas in which they do not occur.

Other species of value were *Coccophagus lycimnia* (Wlk.) and *C. scutellaris* (Dalm.), which parasitise *Pulvinaria* spp. but of which the chief hosts are *Coccus hesperidum* L. and species of *Eulecanium*.

BORISOVA (K. B.). **The injurious Activity of the Hairy Geometrid (*Biston hirtarius* Cl.) in the Flood Forests of the southern Ural Region and its entomophagous Enemies.** [*In Russian.*]—*Trud. zool. Inst.* **16** pp. 457–464, 3 figs., 10 refs. Moscow, 1954.

Lycia (*Biston*) *hirtaria* (Cl.) causes considerable damage to deciduous trees in forests and plantations and also to fruit trees in the south of the Soviet Union, and there was an outbreak of this Geometrid in forest areas along the middle and lower course of the Ural River in 1950–51. The trees attacked were not the same in all places, willows being preferred in some and elms in others. The bionomics of *L. hirtaria*, the larvae of which feed on the leaves and pupate in the soil, are described, largely from the literature [*cf. R.A.E.*, A **3** 49; **13** 473]. Infestation is focal in character, probably owing to the weak flight of the females, and usually sporadic.

The outbreak was controlled in 1951 by natural enemies. A list is given of nearly 30 species of parasites recorded from *L. hirtaria* in the literature, but none of these was found, those reared by the author being the Pteromalid, *Conomorium eremita* (Först.), the Braconid, *Rogas testaceus* (Spin.), and the Tachinids, *Winthemia venusta* (Mg.), *Zenillia* (*Phryxe*) *vulgaris* (Fall.), *Carcelia* sp., and probably *Tachina* (*Tricholyga*) *sorbillans* Wied. In addition, single cocoons of the Ichneumonids, *Campoplegidia* (*Campoplex*) *adjunctus* (Först.) and *Ichneumon* (*Cratichneumon*) sp., which doubtless parasitised *L. hirtaria*, were found in all the foci studied. The larvae were attacked by the predacious Carabid, *Calosoma investigator* (Ill.), and the pupae in some places by mice. The effectiveness of the natural enemies varied from place to place, and the most important were *Conomorium eremita*, *W. venusta*, *Z. vulgaris* and *Calosoma investigator*, all of which were widely distributed.

Conomorium eremita emerged from early July to mid-September, an average of 80–90 individuals appearing from each host pupa, with a maximum of 277. Some 70 per cent. of the adults examined were females, but some of the parasitised pupae contained almost only males. *W. venusta* and *Z. vulgaris* parasitised the larvae, chiefly those in the fifth instar, and deposited up to ten eggs on each, though not more than five parasites completed their development. The activity of these two increased as the summer advanced, maximum parasitism being observed at the beginning of July. Larvae of *W. venusta* left the host pupae at the end of summer and either pupated at once and gave rise to adults shortly after or hibernated and pupated in the following spring. *Z. vulgaris* hibernated in the host pupa as a first- or second-instar larva. The only hyperparasites observed were *Dibrachys cavus* (Wlk.) and *Hemiteles areator* (Panz.), which parasitised *Campoplegidia adjunctus* and *Rogas testaceus*, respectively.

KIR'YANOVA (E. S.) & PUCHKOVA (L. V.). **A new Parasite of the Beet Weevil**—*Neoaplectana bothynoderi* **Kirjanova et Putschkova, sp.n. (Nematoda).** [*In Russian.*]—*Trud. zool. Inst.* **18** pp. 53–62, 7 figs., 16 refs. Moscow, 1955.

Larvae of *Cleonus* (*Bothynoderes*) *punctiventris* (Germ.) taken in beet fields in the Province of Poltava in July 1952 were found to be parasitised by a nematode described as *Neoaplectana bothynoderi*, sp.n. Of the larvae affected, 81·3 per cent. were in the fifth instar, 10·3 per cent. in the fourth instar, and the remainder in the second and third instars. Mortality averaged 13·3–67·5 per cent. and was highest in sites in which fungous infection was lowest. Maximum parasitism occurred at the end of July

or the beginning of August, and its intensity was not affected by ground-water level or treatment of the soil with BHC. Parasitised larvae were motionless, their bodies were filled with a pinkish-yellow fluid, and they remained unaltered for 5–8 days when placed in a humid chamber. Nematodes that completed their development abandoned the host through the skin, no fluid being discharged, but when development was not completed, the skin of the host larva burst and fluid containing large numbers of larval nematodes poured out. The developmental cycle of *N. bothynoderi* has not been studied, but as large numbers of larvae of different sizes occur in a single host, it is assumed that many generations develop within the same host larva.

N. bothynoderi is the second species of its genus to be found in the Soviet Union, the other being *N. feltiae*, which was obtained in 1934 from larvae of *Agrotis* (*Feltia*) *segetum* (Schiff.) in the Province of Votsk, in the Urals.

BORKHSENIUS (N. S.). **New Species of Soft Scales (Homoptera, Coccoidea, Coccidae) of the Fauna of the USSR and adjoining Countries.** [*In Russian.*]—*Trud. zool. Inst.* **18** pp. 288–303, 11 figs. Moscow, 1955.

The new Coccids described include *Didesmococcus koreanus*, sp.n., on cherry, apricot and plum, and *Rhodococcus sariuoni*, sp.n., on cherry, apple and *Spiraea* sp., both in Korea, *Eulecanium ficiphilum*, sp.n., on fig in Persia, and *E. pistaciae*, sp.n., on a wild pistachio (*Pistacia mutica*) in Soviet Armenia.

GUENNELON (G.). **Contribution à l'étude des tortricides nuisibles au feuillage des arbres fruitiers dans la basse vallée du Rhône.**—*Ann. Épiphyt.* **6** no. 2 pp. 165–183, 9 figs., 2 graphs, 19 refs. Paris, 1955.

The leaves of fruit and other trees in the lower Rhône valley are damaged each spring by Tortricid larvae. Investigations near Avignon in 1952–53 showed that the commonest species were *Tortrix* (*Cacoecia*) *rosana* (L.), *T.* (*C.*) *xylosteana* (L.), *T.* (*Pandemis*) *heparana* Schiff., *Argyroploce variegana* (Hb.) and *Acleris* (*Peronea*) *rhombana* (Schiff.). Buds, shoots, leaves, flowers and young fruits are attacked and webbed together, and the injuries caused are briefly described. The larvae are active in March–May, and the trees usually recover and produce new leaves, but cherry trees severely infested by *T. xylosteana* in May 1953 were almost completely defoliated.

As *T. rosana* is the most widespread and injurious, it was studied in greater detail and all stages are briefly described. It was extremely polyphagous, and lists are given of its food-plants near Avignon and elsewhere. In the laboratory, development was rapid only on the leaves of fruit trees, but it was also completed on various low-growing plants, including clover and lucerne. There is only one generation a year, and winter is passed in the egg stage [*cf. R.A.E.*, A **24** 131]. Adults were present during May–July, and maximum numbers were taken between about 20th May and 15th June. The females survived for about eight days at 20°C. [68°F.] and oviposited 2–3 days after emergence, the eggs being laid in groups of up to 100, usually on the bark of trees or shrubs. The larvae hatched in the following spring and pupated in April–June among the leaves on which they had fed. On *Prunus japonica* in the laboratory, at 20°C. and 80 per cent. relative humidity, the duration of the larval and pupal stages together averaged 35–38 days, the five larval instars lasting 4–5 days each and the pupal stage 12–13 days. In the field, the larval and pupal stages were completed

in two months or less on trees with a southern aspect, but lasted about two and a half months on those that were more sheltered from the sun.

Feron (M.) & Sacantanis (K.). **L'élevage permanent de** *Ceratitis capitata* **Wied. au laboratoire.**—*Ann. Epiphyt.* **6** no. 2 pp. 201–214, 3 figs., 15 refs. Paris, 1955.

Investigations were begun in 1949 on a suitable technique for rearing *Ceratitis capitata* (Wied.) continuously in large numbers in the laboratory in France, where this fruit-fly is of considerable importance but is not known to be permanently established [*cf.* *R.A.E.*, A **42** 184]. The main difficulty was the selection of a host fruit available throughout the year, and it was soon found that bananas, which are seldom attacked in nature [*cf.* **39** 34], were suitable if the skin had been previously punctured with a needle. In comparative tests at 25–26°C. [77–78·8°F.] and 60–70 per cent. relative humidity, the egg and larval stages together and (in brackets) the pupal stage averaged 18 (12), 16 (10), 12 (9), and 11 (8) days, respectively, in apple, pear, peach and banana, and averages of 30, 60, 60 and 100 pupae, respectively, were obtained per fruit, with maxima of 64, 82, 120 and 378. The weight of the pupae and the percentage that gave rise to adults varied inversely with the number per fruit, the average weights in mg. being 9·5 for 15 from one pear, 9 for 20 from one banana and 3–6 for 245 from another banana and the emergence percentages being 95, 81, 73 and 65 for 70, 222, 336 and 378 pupae, respectively, from individual bananas.

Cages of two types were developed for rearing, which was carried out at 25–27°C. [80·6°F.] and 70 per cent. relative humidity. One, of wood, glass and wire-mesh, was about 19 × 18 × 13 ins. in size and included a pan of water over a heating element. Light was supplied by two fluorescent tubes with a reflector. When used to obtain eggs, it could accommodate 300–500 pairs of adults, and it was large enough to maintain a stock of 3,000 adults. The second cage was cylindrical, about 10 ins. high and 8 ins. in diameter, and made of transparent plastic and muslin. It had a maximum capacity of 100 pairs. Slices of banana, at the rate of two per 100 flies, were suspended in the cages as food for the adults and changed every 24 hours, and water was provided by means of moist blotting paper. Bananas, with the skin well pricked, were suspended in the cages, two in those of the first type and one in the second, for oviposition, and removed after 24 hours of continuous illumination. They were then kept over dry sand at 25°C. and the pupae collected from the sand after 16 days, just before the beginning of adult emergence.

After preliminary attempts at rearing on other fruits, banana was adopted in 1950, and an average of 87 pupae was obtained per fruit per day over a year, the percentage emergence averaging 70–80. There were 17 generations a year, and a table is given showing the numbers of pupae obtained in March 1954 in five cages of the second type.

Vasseur (R.) & Schvester (D.). **Essais toxicologiques de laboratoire contre la mouche méditerranéenne des fruits** *Ceratitis capitata* **Wied. (Dipt. Trypetidae).**—*Ann. Épiphyt.* **6** no. 2 pp. 215–227, 3 graphs, 7 refs. Paris, 1955.

The tests described were carried out in 1952–53 at a relative humidity of 70–80 per cent. and a temperature of about 21°C. [69·8°F.] for the first two series and about 25°C. [77°F.] for the remainder. In the first four series, the sprays were applied with a hand sprayer from a distance of 32–39 ins., 120 cc. liquid being used to cover eight pears and eight leafy

twigs. When dry, one fruit and one twig were suspended with pieces of banana in a wire-mesh cylinder about 10 ins. high and 4½ ins. in diameter. Two or four containers were prepared in this way for each test, and 20–25 adults of *Ceratitis capitata* (Wied.) reared in the laboratory by a technique already noticed [*cf.* preceding abstract] were released in each 24 hours after the treatment and left for a week. Adults were similarly confined with the remaining sprayed material, 7, 14 and 21 days after treatment, and mortality counts were made at frequent intervals, insects that had ceased all movement being considered dead. The results are given in tables, which also show the time in hours required for 25, 50, 75 or 95 per cent. mortality.

In the first series, the mortality percentages among adults confined with the sprayed material 1, 7, 14 and 21 days after treatment, with (in brackets) the number of hours required to reach the final percentage or the nearest percentage below this shown in the table, were 95 (72), 90 (156), 57·5 (120) and 37·5 (72), respectively, for 0·2 per cent. wettable DDT, 90 (96), 75 (100), 20 and 15, respectively, for an emulsion spray containing 0·06 per cent. DDT and 0·36 per cent. petroleum oil, 100 (72), 82·5 (120), 55 (144) and 32·5 (120), respectively, for one containing 0·03 per cent. parathion, and 100 (60), 87·5 (132), 72·5 (120) and 25 (144) for one containing 0·03 per cent. parathion and 0·8 per cent. petroleum oil. The corresponding figures were 100 (40) and 15 for wettable γ BHC as lindane at 0·024 per cent. one and seven days after treatment, respectively, and there was not more than 5 per cent. mortality in the controls.

In the second series, the corresponding figures 1, 7, 14 and 21 days after treatment were 99 (72), 99 (72), 88·5 (72) and 84 (108), respectively, for 0·2 per cent. wettable DDT, 97·5 (108), 75 (120), 48 (84) and 22·5 for an emulsion spray containing 0·1 per cent. DDT and 0·6 per cent. oil, and 95 (108), 78 (108), 62·5 (120) and 65 (90) for a wettable powder containing 0·02 per cent. rotenone, as compared with 10–20 per cent. mortality for no treatment.

In the third series, in which γ BHC and DDT, alone and together, were tested by the same technique, γ BHC at 0·012–0·024 per cent. exercised such a strong fumigant action one day after application as to cause 74 per cent. mortality in the untreated controls and to invalidate full comparison of treatments. It appeared, however, that γ BHC was more effective in a wettable-powder than in an emulsion spray.

In the fourth series, the sprays were prepared from wettable powders unless otherwise stated, and adults were confined with the treated material 1 and 7 or 1, 7 and 14 days after treatment. The resulting figures, arranged as before, were 94 (24), 78 (108) and 44 (96), respectively, for 0·02 per cent. parathion, 98 (72), 92 (60) and 44 (96) for 0·03 per cent. parathion, 98 (96), 48 (84) and 30 (120) for 0·1 per cent. DDT, 54 (96) and 12 for 0·02 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], 80 (120) and 16 for 0·03 per cent. Diazinon, 94 (60), 78 (72) and 58 (120) for an emulsion spray containing 0·8 per cent. petroleum oil and 0·03 per cent. parathion, 100 (96), 76 (144) and 42 (120) for a mixture of 0·1 per cent. DDT and 0·02 per cent. parathion, and 68 (84), 30 (120) and 4 for 0·1 per cent. DDT and 0·02 per cent. Diazinon, as compared with 6–10 per cent. mortality for no treatment.

In the fifth series, peaches sprayed one or six days previously were introduced in pairs into cages containing numerous adults, removed after 48 hours, and kept for ten days at 25°C., after which they were examined for infestation. The insects found in the pairs of fruits comprised 128 pupae for 0·2 per cent. wettable DDT, none for 0·03 per cent. parathion emulsified solution, 12 pupae for an emulsion containing 0·03 per cent. parathion and 0·8 per cent. oil, and 279 pupae for 0·02 per cent. rotenone

in those exposed one day after treatment, as compared with 193 pupae in the controls, and 36 pupae, one living larva and ten dead larvae for DDT, three dead larvae for parathion alone, and six pupae, one living larva and ten dead larvae for parathion with oil in those exposed six days after treatment, as compared with 56 pupae in the controls.

It was noted that γ BHC in wettable powders was very rapid in action, giving 50–60 per cent. knockdown in four hours, but rapidly lost its toxicity. The variation in the results given by DDT is believed to be partly due to variations in the resistance of the flies with age and sex [*cf. R.A.E.*, A **43** 15] and the different temperatures at which the tests were carried out. It appeared to have a somewhat repellent effect. Wettable parathion proved unusually persistent, and its toxicity in emulsions to larvae inside the fruits was notable [*cf.* **42** 359, etc.].

BILIOTTI (E.), CHARMET (F.) & GRISON (P.). **Études sur les traitements par brouillards insecticides en forêt.**—*Ann. Épiphyt.* **6** no. 2 pp. 229–284, 22 figs., 73 refs. Paris, 1955.

In view of sporadic outbreaks of *Thaumetopoea processionea* (L.) on oak and *T. pityocampa* (Schiff.) on pine in forests in France in recent years [*cf. R.A.E.*, A **42** 406–7], studies were made on the use of insecticidal aerosols for the control of forest pests, and an account is given of experiments with these and of the methods used to evaluate the results. The authors review from the literature the characteristics of outbreaks of *T. processionea* and *T. pityocampa* and of other Lepidopterous defoliators of forest trees in France, record the results of investigations on the most suitable periods for the application of control measures [*cf. loc. cit.*], and discuss, also mainly from the literature, factors that affect the successful application of insecticides in forests, including the variations in temperature at different heights above the ground, the properties of the insecticides used, the evenness of distribution of the product throughout the area to be treated, and the relation of particle size to this, techniques for applying insecticides, and the estimation of the efficacy of the treatments.

The experiments were begun in 1952 with a proprietary aerosol fog generator of a new type, in which the fog is produced by the azeotropic distillation of the insecticide incorporated into granules with an appropriate chemical mixture; distillation is effected at a temperature just above the melting-point of the mixture and much below the boiling-point of the insecticide, so that there is no risk of decomposition of the latter. Since preliminary tests in a fumigation chamber showed that complete mortality of first-instar larvae of *Malacosoma neustria* (L.) was given in two days by exposure for 15 minutes to 5 mg. technical BHC per cu. m., it was estimated that a dosage of 1·8 lb. BHC or 0·9 lb. DDT per acre would give satisfactory results under field conditions. Two tests were carried out over an area of some 30 acres in an oak forest in the Oise valley early in April 1952, just before bud-burst. For estimation of the results, colonies of first-instar larvae of *M. neustria*, reared in the laboratory, were exposed 13 ft. above the ground on poles erected about 100 ft. apart along four lines (with 9–13 poles in each line) approximately parallel to the direction of the wind, which was light, and at right-angles to the line along which the generators were placed. The larvae were provided with food and examined for mortality after a week. In addition to these, open petri dishes containing filter paper were attached to the poles and removed to the laboratory after treatment, where adults of *Ceratitis capitata* (Wied.) were confined in them and observed for mortality after 24 hours. The fogs were released in the first test from nine generators about 130 ft. apart and in the second from four

generators 260 ft. apart. They passed through the trees in about 6–8 minutes, and a total of some 44 lb. technical BHC was applied in each test. The results on the experimental insects are analysed statistically and shown in a table. In the first test the calculated mortality percentages averaged 34·7 for *Malacosoma* and 54 for *Ceratitis*, and in the second they were 64·6 and 29·8, respectively. There were wide variations in the results between individual poles, and though there were no significant differences due to distance from the line of emission, there were differences between lines at right-angles to it, probably owing to deflection of the fog by trees or air currents near the generators. The distribution of the insecticide appeared to be more uniform in the second test, where the amount released per generator in unit time was about double that in the first test.

The later tests were carried out in 1953–54 with the TIFA machine (Todd Insecticidal Fog Applicator) [*cf.* **35** 259]. In the first two, small cages containing first-instar larvae of *M. neustria* or *T. processionea* were attached to the poles, which were disposed in groups of three or four about 32 ft. apart and 130 or 195 ft. from the point of emission. In the first test, the temperature was 10–12°C. [50–53·6°F.], the relative humidity 75 per cent. and the wind speed some 2–4½ miles per hour, and in the second, the temperature was slightly higher and the wind irregular. The fogs were released from a product containing 8 per cent. lindane [almost pure γ BHC] in shark oil, diluted in kerosene to give 2 per cent. γ BHC, and a mixture containing 8·8 per cent. p,p′DDT. The duration of the emission was 45, 90 or 180 seconds, the output of the apparatus being one litre per minute. Observations on the test insects made every 24 hours showed that mortality was complete for both products four days after treatment for 90 seconds at a distance of 130 ft., and on this basis three further experiments were designed.

In the first, carried out on oak in May 1953, precise data on mortality were not obtained, but it appeared that young larvae of *Malacosoma* suspended on a level with the tops of the trees by means of meteorological balloons were affected to the same degree as those at ground level or at a height of 13 ft., the product used containing 20 per cent. DDT and 3·5 per cent. γ BHC, diluted 4 : 1 with gas-oil. The second experiment was carried out in November on trees about 30 ft. high, covering some 10 acres and flanked on two sides by dense undergrowth. Larvae of *M. neustria* artificially induced to hatch in autumn were suspended at about 30 ft. by means of balloons, in a plot about 325 ft. by 245 ft. in the centre of the treated area. A solution of 8 per cent. γ BHC in shark oil, diluted 4 : 15 with kerosene, was used to apply 0·144 lb. γ BHC per acre. It was emitted from 10 fixed points about 100 ft. apart, each emission lasting 90 seconds. The temperature was about 6°C. [42·8°F.], the wind speed was almost nil, and there was a slight mist. Mortality of *Malacosoma* reached about 40 and over 60 per cent. in 24 and 48 hours, respectively, the insecticide was distributed fairly evenly over the whole of the experimental area and the undergrowth did not constitute a hindrance. Larvae of *T. processionea* in the late first instar, exposed about 3 ft. above the ground, were not killed, though those of *M. neustria* at the same site were all dead after five days. This experiment was repeated in March 1954, when the dosage was reduced to 0·1215 lb. γ BHC per acre and the *Malacosoma* larvae were exposed on 13-ft. poles. Mortality reached about 40 per cent. in 24 hours, but the results were less uniform than in November, probably owing to the decreased height at which the insects were placed and a somewhat stronger wind.

The authors stress the importance of a study of the effects of such treatments on the whole insect fauna of the forest and give a list of insects found affected in the course of the experiments.

THOMAS (W. D. E.), BENNETT (S. H.) & LLOYD-JONES (C. P.). **The Absorption, Breakdown and systemic Behaviour in Plants of ^{32}P-labelled Demeton-S.**—*Ann. appl. Biol.* **43** no. 4 pp. 569–593, 1 pl., 1 graph, 22 refs. London, 1955.

The following is substantially the authors' summary. An account is given of investigations on the general behaviour of diethyl S-2-(ethylthio)ethyl phosphorothiolate (demeton-S), labelled with ^{32}P, after application in aqueous emulsions to the leaves of broad beans (*Vicia faba*), apple and *Coleus* and to the roots of broad beans growing in soil or sand. After application to the leaves, evaporation, breakdown into toxic non-volatile compounds and absorption occurred concurrently and removed unchanged demeton-S from the leaf surface within a few hours. The evaporation resulted in a fumigant action on *Aphis fabae* Scop. on the upper leaves of broad-bean plants of which the lower leaves had been sprayed [*cf. R.A.E.*, A **43** 9]. Both demeton-S and its degradation products were absorbed, the former degrading rapidly within the plant tissue [*cf.* **43** 405]. Translocation from treated leaves was never sufficient to kill Aphids feeding on the untreated foliage. In no instance following leaf application could any unchanged demeton-S be found elsewhere in the plant. Analyses showed a higher proportion of primary toxic degradation products in the treated than in the untreated leaves. Following root application to broad beans in soil or sand, Aphids feeding on the shoot tips were killed in two days; unchanged demeton-S was translocated after root application. Demeton-S and its toxic derivatives appeared to move much more freely in xylem than in phloem tissue; movement from xylem to phloem must occur, but subsequent transport within the latter tissue is limited. Autoradiographic evidence confirmed the limited extent of movement within leaves.

DAVID (W. A. L.) & GARDINER (B. O. C.). **The aphicidal Action of some systemic Insecticides applied to Seeds.**—*Ann. appl. Biol.* **43** no. 4 pp. 594–614, 1 fig., 8 refs. London, 1955.

The effectiveness of systemic insecticides applied to seeds for the protection of the growing plants was investigated in the laboratory in Britain. In preliminary tests, seeds of cabbage, french bean and broad bean [*Vicia faba*] and seed balls of sugar beet were soaked for four or 24 hours in aqueous dilutions of schradan, dimefox (bis(dimethylamino) fluorophosphine oxide), sodium fluoroacetate or demeton, which comprises a mixture of diethyl 2-(ethylthio)ethyl phosphorothionate (demeton-O) and diethyl S-2-(ethylthio)ethyl phosphorothiolate (demeton-S) [*cf. R.A.E.*, A **43** 405], all at 1 and 0·2 per cent., or in paraoxon at 0·1 per cent., and the resulting plants were infested with *Myzus persicae* (Sulz.), *Aphis fabae* Scop. or, in the case of french bean, *Tetranychus telarius* (L.); some tests were also carried out with potato tubers soaked in dilutions of the first four materials. The demeton dilution was prepared from Systox 50 emulsion concentrate and, unlike the others, contained an emulsifier [*cf.* **43** 8]. At either concentration, it prevented natural infestation of cabbage by Aphids, but not by *Aleurodes proletella* (L.) (*brassicae* (Wlk.)), and it had no effect on *M. persicae* placed on the plants 25 days after seed treatment. Both concentrations injured french beans, and demeton at 0·2 per cent. killed potato tubers, but treatment of the tubers with 0·1 per cent. demeton did not prevent growth and the plants were toxic to *M. persicae* 63 days later. Demeton and schradan at either concentration rendered broad-bean plants toxic to Aphids, and complete kill was still obtained 60 and 20 days after treatment, respectively; plants treated with demeton were still toxic after 75 days. Schradan and dimefox both killed *T. telarius* on french-bean

plants 41 days after treatment. The other materials were either ineffective or injurious, and the tests with sugar beet were inconclusive owing to the difficulty of establishing *A. fabae* on the young plants.

Since the results with the smaller seeds were unsatisfactory, only broad beans were used in the further tests, which were carried out with demeton or demeton-S, the latter in some cases labelled with ^{32}P. The following is almost entirely the authors' summary of the results. Beans soaked in solutions of radioactive demeton-S absorbed almost equal quantities of water and demeton-S. They varied greatly in the rate of absorption, and to reduce this variation, soaking for about 24 hours was necessary. The insecticidal activity of the plant was directly related to the quantity of solution absorbed. Larger seeds absorbed more than small ones, and the plants were more toxic to Aphids. After short periods of soaking in demeton-S (four hours) there was more insecticide in the seed-coat than in the cotyledons, but after soaking for 24 hours, most was in the cotyledons. The toxic material in the cotyledons passed directly to the growing plant, but some of it may pass into the soil and reach the plant by way of the roots. Any factors, such as an increase in soil volume or heavy watering, that tend to dilute the insecticide in the soil reduce the quantity of toxic material reaching the plant. The same quantity of demeton-S was more effective when absorbed by a seed than when watered on to the soil around it. Seeds soaked in insecticide, dried, and stored in open jars for one month gave rise to plants that were toxic to Aphids.

HASSALL (K. A.). **Relationships between the chemical Constitution and fumigant Toxicity of the Alkyl Iodides.**—*Ann. appl. Biol.* **43** no. 4 pp. 615–629, 3 graphs, 18 refs. London, 1955.

The following is virtually the author's summary of this account of investigations in which 19 alkyl iodides were tested as fumigants against *Calandra granaria* (L.) by a laboratory technique already noticed [*cf. R.A.E.*, A **42** 408]. Relative toxicities and also the toxicities of mixtures of selected pairs of iodides were determined. Secondary and tertiary isomers were in general less toxic than the primary ones, irrespective of whether toxicity was measured by molar median lethal dose (LD 50) or the corresponding relative saturation value [**37** 412]. Despite differences in LD 50's, isomeric primary iodides often acted at about the same relative saturation value. It is suggested that these observations provide evidence that, although chemical reactivity appears to be the principal factor determining the values of LD 50's in the iodide series, such physical factors as phase distribution also play their part, and their effect becomes noticeable for the primary isomers, for which the chemical reactivities may be nearly the same.

The deaths of individual weevils that had been exposed to iodides were more or less delayed. The change of the kill with time was, under standard conditions, the same when all except methyl and the tertiary iodides were used, which suggests that with these possible exceptions, all the iodides have the same type of chemical action on the organisms. The toxicities of mixtures of selected iodides tended to confirm this, for they varied from about 1 to 1·25 times the value predicted from the toxicities of the single iodides using the similar action equation. Despite the apparent similarity in mode of action the LD 50's and relative saturation values varied widely, as did the ratios of the LD 50's of successive homologues in different isomeric series. This suggests that neither the magnitude of the relative saturation value, nor the way in which it changes from member to member in a series, gives always a useful indication of the type of action shown by a compound or group of compounds.

TATTERSFIELD (F.) & KERRIDGE (J. R.). **The Effect of repeated Spraying of Insects on their Resistance to Insecticides. III. Conditioning by the Administration of sublethal Concentrations.**—*Ann. appl. Biol.* **43** no. 4 pp. 630–644, 4 graphs, 10 refs. London, 1955.

The following is largely based on the authors' summary of this part of a series [*cf. R.A.E.*, A **42** 318, 319]. The administration of carbon dioxide in sublethal concentrations or for sublethal periods to adults of a strain of *Drosophila melanogaster* Mg. susceptible to the toxic effects of this gas increased their resistance to it. The effect did not appear to be permanent. The successive administration by spraying of sublethal concentrations of DDT or γ BHC to adults did not increase the resistance of individuals, and similar treatments with DDT of five successive generations did not increase the resistance to DDT of the sixth generation, provided that the conditioning treatments were kept at a level sufficiently low not to give rise to selection of less susceptible strains or mutants. Only when the conditioning dosages were such as to give a high death rate did a significant increase of resistance in the progeny take place. The tendency of conditioning was, if anything, to increase susceptibility, but there was no indication that DDT acted as a cumulative poison. In a preliminary series of tests, the topical application of DDT in sublethal doses to the adults resulted in a reduction in the number of eggs laid or in the rate of oviposition.

POLLARD (D. G.). **Feeding Habits of the Cotton Whitefly,** *Bemisia tabaci* **Genn. (Homoptera: Aleyrodidae).**—*Ann. appl. Biol.* **43** no. 4 pp. 664–671, 6 figs., 10 refs. London, 1955.

The following is based on the author's summary. *Bemisia tabaci* (Gennadius) is of importance as a pest of cotton in the Sudan because it transmits the virus inducing leaf-curl and also causes direct damage, chiefly in the nymphal stage, by its feeding. Varieties of cotton susceptible or resistant to leaf-curl are both injured by it, and during recent years, especially in 1951–53, the increased use of DDT sprays in the Gezira against *Empoasca lybica* (de Berg.) has caused an increase in the numbers and importance of *B. tabaci* [*cf. R.A.E.*, A **43** 442].

The method of nymphal feeding and its effects on the plant were studied in the Gezira. Chlorotic spots appear on the infested leaves, as a result of the removal of chlorophyll and starch by the saliva of the nymphs, and dark red spots, due to the production of anthocyanin, commonly appear, especially in winter. The Aleurodids produce honeydew in sufficient abundance to cover both surfaces of the leaves late in the season, and it may also contaminate the lint in open bolls; there was some indication that increase in infestation was associated with reduced rate of growth and increased leaf shedding.

The nymphs feed on the lower surface of the leaves, and the investigations showed that their stylets reach the phloem, except when they follow a convoluted path. The stylets usually penetrate between the epidermal cells. Penetration through the parenchyma is predominantly intercellular, and the objective is the phloem. Stylets terminated in the phloem in 82 per cent. of the examples examined, with the remainder ending in the parenchyma. Only one case of partial penetration of the xylem occurred. A stylet, or salivary, sheath, is rare; it is a delicate annular structure. Stylet tracks occur rarely and indicate probing in the region of the phloem. Damage to the tissues is limited to slow chloroplast destruction and occasional plasmolysis; the phloem is neither blocked nor obviously damaged.

Dürr (H. J. R.). **The relative Attractiveness of various Poison Baits to the Argentine Ant, *Iridomyrmex humilis* (Mayr) (Hymenoptera: Formicidae).**—*J. ent. Soc. S. Afr.* **17** no. 1 pp. 93–95, 4 refs. Pretoria, 1954.

The value of grape syrup and molasses as substitutes for the honey or golden syrup used as attractants in poison baits for the control of *Iridomyrmex humilis* (Mayr) in South Africa was tested by a method already described [*R.A.E.*, A **43** 290]. The products were diluted to a 50 per cent. sugar content, and 0·2 per cent. sodium arsenite was then added. No significant difference was found in the attractiveness of baits containing golden syrup, honey or grape syrup, but the bait containing molasses proved significantly less attractive.

Fiedler (O. G. H.). **Lindane Dust for Grain Weevil Control.**—*J. ent. Soc. S. Afr.* **17** no. 1 pp. 115–122, 2 graphs, 9 refs. Pretoria, 1954.

In preliminary tests of the value of γ BHC for the protection of stored grain against insect pests in South Africa, concentrations in the grain even lower than the 2·5–6·5 parts per million recommended in Europe and North America gave rapid mortality, and a further test was accordingly made to determine the dosage-mortality rate for *Calandra* (*Sitophilus*) *granaria* (L.) under the local climatic conditions. Samples of uninfested wheat were mixed with different amounts of a dust containing 0·6 per cent. γ BHC, placed in glass jars, infested with batches of *C. granaria*, and kept at 60·8, 69·9 or 75·2°F. for 19 days. Effectiveness increased with increasing temperature, so that whereas 1·6 p.p.m. γ BHC was required for complete mortality at 60·8 or 69·9°F., 0·4 p.p.m. gave complete kill at 75·2°F. The median lethal doses at these three temperatures were determined as 0·152, 0·107 and 0·086 p.p.m., respectively. Such low rates would not necessarily protect already infested grain, since accumulations of frass have been shown to absorb much of the chemical and prevent contact with the insects. *Calandra* spp. are widely used for the bioassay of γ BHC preparations within the range of 20–160 p.p.m., and it has been stated that contact for 24 hours with deposits of 0·18–1·41 mg. γ BHC per sq. ft. on filter paper or glass does not give complete mortality within five days of exposure. In the present tests, γ BHC at 6·5 p.p.m. always gave complete mortality within this period, although the deposit on the total surface area of the grains was estimated at only 0·6 mg. per sq. ft., which is too low for effective contact action. A fumigant effect must also be involved, and a further calculation showed that γ BHC at 6·5 p.p.m. would provide 370 mg. per cu. ft. of air space in the grain, which is a fairly high concentration.

On the basis of this investigation, the concentration of γ BHC recommended for the protection of grain and other seeds intended for human or animal consumption in South Africa is 2–3 p.p.m. The hazards to the consumer are discussed, largely from the literature, and it is concluded that grain treated at the recommended rate will be harmless, even if uncleaned.

Skaife (S. H.). **The Food of the Black-mound Termite of the Cape, *Amitermes atlanticus* Fuller.**—*J. ent. Soc. S. Afr.* **17** no. 1 pp. 123–133, 1 fig., 1 ref. Pretoria, 1954.

The following is substantially the author's summary. A method is described of keeping moderate-sized termite colonies on a glass-bottomed stand in the laboratory in such a way that the termites can be offered various food substances in tubes, which they reach by burrowing through

sand, and watched while feeding. It should be applicable to many different species and prove useful in testing the effects of poisons, attractants, repellents and other substances. The results of feeding experiments carried out in this way with *Amitermes atlanticus* Fuller over a period of two years are described [*cf. R.A.E.*, A **44** 96]. This species, which is common in the south-western Cape Peninsula in South Africa, does not eat sound dead wood or filter paper. Its natural food consists mainly of stumps, twigs and roots so decayed that they can be broken up in the fingers, and partly rotted vegetation. The termites do not take dry food, and the addition of a little sucrose to the water with which it is moistened makes it much more attractive for them. Their reactions to various sugars, starches, amino-acids, drugs and hormones are recorded.

Norris (M. J.) (Mrs. O. W. Richards). **Sexual Maturation in the Desert Locust** (*Schistocerca gregaria* **Forskål) with special Reference to the Effects of Grouping.**—*Anti-Locust Bull.* no. 18, [2+] 44 pp., 2 graphs, 28 refs. London, 1954.

An account is given of investigations carried out in view of the earlier observation that oviposition is delayed in females of *Schistocerca gregaria* (Forsk.) kept in single pairs with males [*R.A.E.*, A **40** 400]. The adults used were from hoppers reared under crowded conditions, and methods of recognising the state of maturity from colour and weight are described.

The following is taken from the author's summary of the work. Females increase in weight after emergence by about 78 per cent. before appreciable egg development begins. This weight is referred to as their basic weight and in many females it is maintained, with small fluctuations, until mating occurs. After mating, further weight increase is caused by the developing eggs, and after oviposition the weight drops back to the basic weight. In the absence of males, some females oviposit without mating. Readiness for pairing coincides with the beginning of yolk deposition in the eggs. Males increase their weight after emergence by only about 55 per cent., and this basic weight is maintained, with fluctuations, for the remainder of their lives. Readiness to mate is associated with the presence of secretion in the accessory sexual glands, but not necessarily with the presence of spermatozoa in the receptaculum seminis.

When the locusts are kept in single pairs, the period before the first oviposition is highly correlated with the period required for the male to become sexually mature and lasts for an average of ten days after male maturity sets in. Virgin females often oviposit, but usually after a longer pre-oviposition period than when males are present and seldom before the age of four weeks. Most of their eggs fail to hatch, and those that do so all produce females. Many of the pods are laid on the sides of the cage instead of in the sand. The oviposition rate of fertilised females falls after a week if males are removed from the group, but eggs laid even ten weeks later are still fertile. Once fertilisation has occurred, mating is therefore necessary more as a stimulant to oviposition than for renewed fertilisation. Sexual maturation in both sexes is accelerated by superficial injuries such as loss of legs or antennae or slight wing deformities. The tendency of virgin females to oviposit is increased by such injuries.

Mature males exert an influence on immature ones which, when they are kept in single pairs, accelerates maturation and causes them to become yellow as though in crowded conditions. The average maturation time for 13 batches of males isolated with single mature males was 17·1 days; 74 per cent. of the males became more or less fully yellow. The average maturation time for 13 corresponding batches of males isolated with single females

of their own age was 27·6 days; only 7 per cent. of the males became fully yellow. Experiments showed that the influence of the mature male was attributable to a chemical stimulus, the effectiveness of which, particularly with regard to yellowing, is reduced when the locusts are separated by a perforated partition, but which can be perceived by olfactory means if strongly exerted. Ovarial development in the female is also stimulated, often to the point of oviposition, by the presence of mature males, even though mating does not occur. Mature females exert a weaker stimulus inducing accelerated maturation and yellowing in males, but it is fully effective only under crowded conditions and usually ineffective in producing yellowing except when the male is becoming mature. Very young immature males and females (less than eight days old), on the other hand, exert a retarding influence on male maturation; this is apparent both in crowded conditions and in single pairs, at least when the pairs are confined in a small cage. Such young locusts do not induce yellowing in mature males, even under crowded conditions.

CHAPMAN (R. F.). **A Laboratory Study of roosting Behaviour in Hoppers of the African Migratory Locust** (*Locusta migratoria migratorioides* **R. & F.**).—*Anti-Locust Bull.* no. 19, [2+] 40 pp., 26 figs., 46 refs. London, 1955.

The following is virtually the author's summary. A study was made of the effects of micro-climate on the behaviour of hoppers of *Locusta migratoria migratorioides* (R. & F.), with particular reference to roosting. The experiments were carried out in a large cage 6 ft. × 4 ft. × 6 ft. high in a room with controllable heat, light and humidity, and an electric heater was arranged so that it could be used as a source of radiant heat. Vertical sticks were provided to serve as roosting sites.

The most important factor in the morning awakening of the roosting hoppers is a positive thermokinesis; there is a possibility of positive photokinesis at low temperatures. The experiments failed to demonstrate any directed response to light, but a negative response to gravity was exhibited at 20°C. [68°F.]. The morning ascent higher up the roosts is the result of a negative geotactic response together with a chance movement dependent on the habit of the hoppers of sitting head upwards on the sticks overnight. Movement resulting in exposure to sunlight is distinct from the morning ascent. and experiments in which the sources of light and radiant heat were separated showed that this exposure results from random movements and depends on radiant heat.

The morning descent of hoppers is divided into the descent proper and the vacation of the roosts. The descent proper is the downward movement of the hoppers, and this increased with temperature. Different humidities, whether general or local in effect, did not influence the movements of hoppers, and no difference was observed in their movements in different light intensities from 10 to 1,000 metre-candles, nor did increasing intensity have any effect. Hoppers appeared to be unable to follow a temperature gradient, and no difference in vacation of the roosts was observed, whether the air temperature gradient was inverted or not. The vacation of the roosts increased with temperature to 25°C. [77°F.], but further increase in temperature did not produce a further descent. Descent of all hoppers is only achieved when ground temperature exceeds air temperature so that conditions are suitable for basking; otherwise hoppers re-ascend after coming down. Wind had no mechanical effect in the conditions of the experiments. but sudden gusts producing cooling caused an increase in activity.

Hoppers start to ascend the roosts in the evening when the ground conditions cease to be suitable for basking, but they only remain on the roosts if their state of activity is low. Food is important in reducing activity, and more hoppers remain on the roosts in the presence of food, whether or not this is on the sticks. Humidity and smell of food are unimportant. The available roosting area is a limiting factor in the laboratory, but probably not in the field. High air temperature reduces roosting by increasing activity. Light intensity is of no importance and an ascent can occur in darkness.

The possible biological significance of roosting is discussed. Roosting may contribute to the commencement of outbreaks by promoting aggregation.

VESEY-FITZGERALD (D. F.). **The Vegetation of the Outbreak Areas of the Red Locust** (*Nomadacris septemfasciata* **Serv.) in Tanganyika and Northern Rhodesia.**—*Anti-Locust Bull.* no. 20, [2+] 31 pp., 8 pls., 15 refs. London, 1955.

The following is based on the author's summary. Swarms of *Nomadacris septemfasciata* (Serv.) are known to originate in the Rukwa valley and the Malagarasi basin in Tanganyika and the Mweru wa Ntipa depression in Northern Rhodesia [*cf. R.A.E.*, A **36** 171, etc.], and a comparison of the vegetation of these three areas was made to facilitate recognition of other potential outbreak areas. All three have one dry and one rainy season each year, and the various types of grassland present are dependent on the type of drainage. Open woodland grows on the raised land, a woodland-grassland formation with a ground cover of tall grasses is established along the sides of the valleys, and there is open grassland with few trees in the valley bottoms, flanking the watercourses. Where the drainage is impeded, vast open plains occur, and these form the locust habitat. Dense beds of *Echinochloa pyramidalis* characterise areas of accumulation of land drainage, semi-permanent fresh-water swamps in which the water-grass, *Vossia cuspidata*, usually predominates prevail in lower places in which the water is deeper and stands longer, and various species of Cyperaceae characterise areas around lagoons and fresh-water lakes. Further types of grassland occur round the Rukwa and Mweru wa Ntipa depressions, which have no outlets and in which there are shallow saline lakes that sometimes dry up. These comprise lake-shore grasslands characterised by *Diplachne fusca*, and the dry beds of the lakes, which are colonised mainly by *Sporobolus spicatus*. The herbage grows robustly during the rains or floods, but dries off during droughts, so that the soil is exposed, and annual fluctuations in precipitation and flooding lead to great variations in ground cover, especially in the zones of contact between the various grassland types. These influence the abundance of *N. septemfasciata*, but the permanent habitats of the locust are usually grasslands characterised by the co-dominance of two grasses, each of which tends to grow by itself. They are often of very different height, so that mosaics of tall and short species are formed. Within the mosaic, the contact between the species may be close, but bare patches may occur under drought conditions.

GUICHARD (K. M.). **Habitats of the Desert Locust** (*Schistocerca gregaria* **Forskål) in western Libya and Tibesti.**—*Anti-Locust Bull.* no. 21, [2+] 33 pp., 10 pls., 4 maps, 15 refs. London, 1955.

The following is virtually the author's summary. Descriptions are given of western Libya (Tripolitania and the Fezzan) and a part of the lowlands

bordering the Tibesti massif in the north of the Chad Territory of French Equatorial Africa, with special reference to the habitats of *Schistocerca gregaria* (Forsk.). The evidence suggests that non-swarming populations of this locust are present in one part or another of this vast region according to the distribution of rainfall. There is indirect evidence of not infrequent migrations of adult solitary locusts, sudden appearances of which cannot be accounted for in any other way. Incipient swarming during years of good rainfall in the Fezzan and the Harug el Asued, and subsequent southward migration, may occur occasionally and irregularly. Evidence is presented of spring breeding on a swarming scale of unknown intensity in the Harug el Asued in 1927 and 1933, and of swarm breeding in Tibesti during the winter of 1949–50 when that area and the surrounding regions were supposed to be clear of swarms. The possibility of a summer generation of locusts being produced in the Fezzan is considered most unlikely. During 1952, a spring generation of *Schistocerca* on a scale large enough to produce at least incipient swarming was witnessed in the northern Fezzan. In 1953, small-scale spring breeding of a different nature was seen in northern Chad Territory. The vegetation of these two breeding areas is described and the characteristics of it that tend to promote hopper congregation in the Fezzan plant communities are noted. The opposite characteristics, inhibiting congregation, are associated with the presence of *Schouwia* as a dominant plant and are to be found in Chad Territory. The incidence, survival, movement and egg-laying of *Schistocerca* are discussed in relation to the type, composition and seasonal condition of desert vegetation.

Vuillaume (M.). **Biologie et comportement, en A.O.F., de** *Zonocerus variegatus* **L. (Orth. Acrididae), avec essais de comparaison entre acridiens grands et petits migrateurs.**—*Rev. Path. vég.* **33** (1954) fasc. 3 pp. 121–198, 34 figs., 3 pp. refs. Paris [1955].

Zonocerus variegatus (L.) is injurious to crops throughout French West Africa, and as little was known of the bionomics and behaviour of this grasshopper, observations were made in the field in the Ivory Coast and in the laboratory both there and in France, in the hope that light might be thrown on the behaviour of migratory locusts. *Z. variegatus* flies seldom and only for short distances, but the hoppers form bands that march in a manner similar to that of locust hoppers. The distribution of *Z. variegatus* and similar work by other investigators are reviewed, and the damage caused to crops is summarised [*cf. R.A.E.*, A **19** 371; **23** 356; **28** 410]. The young hoppers skeletonise leaves, and the older ones attack the bark of trees and shrubs; if the stems are young or soft, cassava [*Manihot utilissima*], castor [*Ricinus communis*] and maize may be completely destroyed. *Z. variegatus* also occurs in forest plantations if the undergrowth has been cleared.

The observations on its bionomics showed that egg pods, containing 30–120 eggs each, are deposited in the soil in the shade of shrubs and bushes during February–April, each female depositing 2–5, and as many as 100 were found per sq. metre. The egg stage lasted 6–7 months and included an initial diapause of about 3½ months; at a constant temperature of 32°C. [89·6°F.], it was reduced to five months. Hatching occurred in September–November, and nymphal development lasted 3½ months, the adults becoming sexually mature 15 days after the final moult. In the laboratory, the nymphs, especially the younger ones, showed a preference for *Ricinus* and *Ageratum* [*cf.* **15** 488]. It was possible to rear them solely on these plants and on cassava, but not on coffee. The nymphs developed more quickly, consumed more food, were heavier, and accumulated more fat when reared in pairs than singly or in larger numbers, and in addition, fewer died. The effect

of grouping was greatest and most favourable in the first instar and became unfavourable in the fifth and sixth instars. All stages preferred temperatures of 36–40°C. [96·8–104°F.], but none showed humidity preferences. **Yellow and** orange backgrounds were attractive, and actograph records **showed that activity was greatest by day.**

At evening, the hoppers congregate on the tallest available stalks of grass or other herbaceous plants or on small bushes, and investigations on the stimulus that causes them to do so indicated that the movement is a response to the visual perception of tall objects rising above the horizon and not to humidity, temperature (although it does not take place until the temperature falls to 40°C.) or, solely, to light. The nymphs did not congregate on plants in shade or frequent the shaded parts of tree trunks. They were better able to climb a vertical than an inclined object and were not influenced by its colour, though its diameter was important, since they climbed a rod 1 cm. in diameter and a rope, but not a thin, bare wire. The distance at which the objects were perceived increased with their thickness; grass stems were perceived from rather more than a yard away. The nymphs began to assemble on the vegetation after 4 p.m. but did not settle till 5 p.m. Any that reached the highest available point before that time jumped off again, and some began to climb too late to reach the highest point before activity ceased at 5.30–6 p.m. In the morning, the hoppers descended in response to hunger or to reach a preferred food-plant.

In the field, nymphs in all instars occur in relatively dense but unstable groups, and laboratory experiments and field tests with marked individuals indicated that the tendency to form groups is due largely to visual stimulus; nymphs tended to approach others within a distance of about 6 ft. and moved towards any that jumped. Migration in *Z. variegatus* differed from the movement of locust bands in the slow rate of progression, the nymphs covering only a few yards per day, and in the looseness of the grouping, and resembled it in the constant direction followed, which may persist for several days, and the part played by orientating agents. The nymphs do not migrate until the fourth instar is reached. They were attracted by tall animate or inanimate objects rising above the horizon from distances that increased with the bulk of the object, but avoided a screen of trees. They also moved towards the land with the steepest upward slope, and, in observation areas, the same route was followed year after year by individuals of successive generations with only slight deviations. When no conspicuous object is visible, the nymphs orientate themselves by the sun, which they face. Humidity, temperature and wind did not appear to influence migration, and preferred plants or other food were at times left or passed by.

SZUMKOWSKI (W.). **Lista de plantas hospederas de** *Anthonomus grandis* **Boh. en Venezuela.** [A List of Food-plants of *A. grandis* in Venezuela.]—*Agron. trop.* **4** no. 1 pp. 29–42, 2 figs., 8 refs. Maracay, 1954. (With a Summary in English.)

Since *Anthonomus grandis* Boh. develops continuously throughout the year in Venezuela [*cf. R.A.E.*, A **42** 371], investigations on the plants on which the adults feed during the period when cotton is not available were begun in 1950. In the laboratory, adults were enclosed with shoots, buds or green fruits of plants of 133 species in 39 families. The adults were known to survive for up to 155 days on cotton [*cf. loc. cit.*], and the numbers of days for which they survived on the test plants were expressed as percentages of this maximum. Survival for ten days or less was disregarded, since adults survived for up to nine days when no food was provided. A systematic list is given of the plants tested, showing the

resulting percentages. Only *Cienfuegosia affinis* was as favourable as cotton, but the percentages were high on several other malvaceous and sterculiaceous plants. Adults were observed feeding on several malvaceous plants in the field between November 1952 and July 1953. These, with in brackets the percentages obtained in the laboratory tests, comprised *C. heterophylla* (86), *Wissadula contracta* (37), *Abutilon giganteum* (34), *A. hirtum* (30), *Sida* sp. (20–33), *Hibiscus esculentus* (50), *H. rosa-sinensis* (43–65), *H. syriacus*, *H. mutabilis* (30), and *Thespesia populnea* (10). Though *A. grandis* can thus survive on wild food-plants when cotton is not available, the destruction of the cotton plants after harvest and of all abandoned and wild cotton is urged, since large populations build up on these and threaten the new cotton crop in its early stages [*cf.* **43** 445].

KERN (F.). **Observaciones sobre un caso de preferencia en el ataque de** *Aeneolamia varia tomentosa* **Fenn. en pastos.** [Observations on a Case of Preference in Attack by *A. v. tomentosa* on Pastures.]—*Agron. trop.* **4** no. 2 pp. 99–100, 2 figs. Maracay, 1954.

Small patches of *Panicum maximum* that had survived because of irregularities in the terrain in a two-year old sown pasture of *Hyparrhenia rufa*, near Rubio, in the Venezuelan State of Táchira, were observed in 1954 to be heavily infested by *Aeneolamia varia tomentosa* Fennah. *H. rufa* was itself not infested.

COPPEL (H. C.) & MAW (M. G.). **Studies on Dipterous Parasites of the Spruce Budworm,** *Choristoneura fumiferana* **(Clem.) (Lepidoptera: Tortricidae). III.** *Ceromasia auricaudata* **Tns. (Diptera: Tachinidae).** —*Canad. J. Zool.* **32** no. 3 pp. 144–156, 16 figs., 11 refs. Ottawa, 1954. **IV.** *Madremyia saundersii* **(Will.) (Diptera: Tachinidae).**—*T.c.* no. 4 pp. 314–323, 16 figs., 16 refs.

These papers, dealing with the Tachinids, *Ceromasia auricaudata* Tns. and *Madremyia saundersii* (Will.), respectively, are the third and fourth of a series on the Dipterous parasites of *Choristoneura fumiferana* (Clem.) in British Columbia [*cf. R.A.E.*, A **43** 134]. They contain descriptions of the immature stages and reproductive organs of the two parasites and accounts of laboratory observations on their bionomics.

Ceromasia auricaudata is one of the most important of the Diptera reared from *Choristoneura fumiferana* in British Columbia, and since 1943 over 20,000 adults have been produced in the laboratory and liberated against this insect in eastern Canada [*cf.* **36** 78] and the eastern United States. Its only other recorded field host is *Hyphantria cunea* (Dru.) [**38** 487], but it readily parasitised *Pieris rapae* (L.), *Galleria mellonella* (L.) and *Pyrausta nubilalis* (Hb.) in the laboratory, *H. cunea* and *Tortrix* (*Archips*) *cerasivorana* (Fitch) proving less suitable. Rearing was carried out at a day temperature of 23°C. [73·4°F.] and a night temperature of 15·6°C. [60·08°F.] and the relative humidity was 60 per cent. The adults were provided with crushed raisins and 10 per cent. honey solution as food and were sprayed twice daily with water, and as the eggs are ingested by the prospective host larvae, small pieces of the food of the latter were supplied for oviposition. When 3–5 eggs had been deposited on these, they were transferred to vials containing host larvae that had been starved for 24 hours. The females paired 1–11 and the males 2–15 days after emergence, and the pre-oviposition and oviposition periods lasted 10–12 and 3–26 days, respectively. Uningested eggs remained viable for at least 14 days at 23°C. and 21 at 6–7°C. [42·8–44·6°F.]. The larvae hatched as soon as the eggs were ingested, and moved

to the lateral longitudinal muscles of the third and fourth abdominal segments of the host, where they remained in the first instar until the host pupated, this period being as long as eight weeks in *P. nubilalis*. The second and third instars each lasted 3–4 days. In mature larvae of *C. fumiferana*, development from egg consumption to pupation averaged 10·34 days. In *Pieris rapae*, development in overwintering pupae was prolonged, the parasites remaining in the second or third instar, often for 3–4 months and even at temperatures suitable for development. The older larvae fed voraciously on the body contents of the host, escaped when full-fed and fell to the ground, where they pupated within 24 hours. The adults emerged 9–11 days later. In the laboratory, adult males survived for up to 30 days and females for 13–48. Adults of the F_1 generation comprised equal numbers of males and females, but the next generation invariably consisted of males only. The total number of eggs laid per female and the number per day averaged 523 and 64·4, respectively; most eggs were laid about the middle of the oviposition period, and although any surface was used, the edges and lower surfaces of foliage were preferred. In British Columbia, the adults appeared at altitudes of 1,000, 2,000 and 3,000 ft. from 18th June to 24th July, 8th July to 8th August, and 11th July to 9th August, respectively. Two generations develop during the summer, but no larvae of *C. fumiferana* and very few of other Lepidoptera are present when the second of these emerges. The adults were exceptionally abundant after those of *C. fumiferana* appeared; in collections made over a period of eight days, only males were obtained during the first six days, and they still preponderated during the last two.

M. saundersii has been obtained in moderate numbers each year since 1943, and since it was not abundant in eastern Canada, over 7,000 adults were liberated against *Choristoneura* there and some were sent to New York. In the laboratory investigations, this parasite was reared at 23°C. and 60 per cent. relative humidity on *C. fumiferana*, *P. rapae* and *Pyrausta nubilalis*, larvae of which were caged with the fertilised females. Adults kept under the same conditions as those of *Ceromasia auricaudata* paired readily, the females one day and the males 2–3 days after emerging. The pre-oviposition period, the first, second and third larval instars, and the period within the puparium lasted 5–7, 2–3, 3–4, 2–3 and 9–12 days, respectively, and the eggs hatched soon after deposition. Adult females survived for 20–60 days, and males for up to 25 days. The females deposited small numbers of eggs each day, and the total number per female was 75–100. Several eggs may be deposited on one host, mostly on the dorsal and lateral regions of the thorax, and usually only one parasite completed its development. The parasite larvae remained in the fatty tissue surrounding the alimentary canal until they reached the third instar, when they consumed the body contents and subsequently left the host, which may then be in the larval or pupal stage, and pupated in the soil. Winter is probably passed in the first or second instar. In overwintering larvae of *P. nubilalis*, the development and subsequent emergence of the parasite were often delayed by as much as 38 days. Adults did not survive the winter in the laboratory. In British Columbia, the adults emerged during the first week in July at an altitude of 1,000 ft., between 7th and 21st July at 2,000 ft., and between 21st July and 7th August at 3,000 ft. They were scarce below 1,000 ft. and most numerous at 2,000–4,000 ft., which is the centre of the vertical range of *Choristoneura fumiferana*. Two parasites sometimes developed from one field-collected host larva, but one was the usual number. The parasite completes one generation in *C. fumiferana*, and there is a later one in an alternative host in which it can overwinter. Three generations a year may occur in some areas. When *M. saundersii* attacks hosts already

parasitised by *Phytodietus fumiferanae* Rohw., the latter succumbs. The puparia are often destroyed by the hyperparasite, *Amblymerus verditer* (Nort.).

Baldwin (W. F.). **Acclimation and lethal high Temperatures for a parasitic Insect.**—*Canad. J. Zool.* **32** no. 3 pp. 157–171, 6 figs., 26 refs. Ottawa, 1954.

The effect of temperature on the survival of females of *Dahlbominus fuscipennis* (Zett.), a parasite of *Gilpinia* (*Diprion*) *hercyniae* (Htg.), was investigated in Canada in experiments in which the criterion was the time required for 50 per cent. mortality. As *G. hercyniae* was scarce, the laboratory host was *Neodiprion lecontei* (Fitch). The parasites were significantly more resistant to temperatures of 40–46°C. [104–114·8°F.] when reared at 29°C. [84·2°F.] than when reared at 17 or 23°C. [62·6°F. or 73·4°F.], and there was usually no significant difference in the resistance of those reared at the two lower temperatures. Individuals reared at 29°C. were less resistant to temperatures of 17–38°C. [100·4°F.] than those reared at 23 or 17°C. When adults that had been reared at 23°C. and a saturation deficiency of 8 gm. per cu. m. were exposed to temperatures of 42 and 43°C. [107·6 and 109·4°F.], the period to 50 per cent. mortality decreased with age, falling from 210 minutes for adults 15 hours old to 62 for those 96 hours old at 42°C. and from 180 minutes for adults 30 minutes old to 38 for those 95 hours old at 43°C.; the decrease in resistance with age is attributed to effects of starvation similar to those recorded for a mosquito [*cf. R.A.E.*, B **22** 56] and was most rapid during the first 25 hours. When adults reared and subsequently kept for 24–96 hours at 29, 23 or 17°C. and a saturation deficiency of 5 gm. per cu. m. were exposed to 43°C., those reared at 29°C. and kept for 24–48 hours were almost twice as resistant as those reared at 17°C. and more than twice as resistant as those reared at 23°C. As Necheles (1924) found that the evaporation rate of water from a cockroach was low between 13°C. [55·4°F.] and 23°C. and greatly increased above this temperature range, the greater resistance of the parasites reared at 29°C. was probably associated with a reduced water content due to this factor, and though there would be no difference in evaporation rate between those reared at 17 and 23°C., the greater duration of development at 17 as compared with 23°C. (24 as compared with 16 days) would also lead to a reduced water content and explain the observed difference in resistance between them. The resistance of examples reared at 29°C. decreased markedly with age, but that of the individuals reared at 17° and, in contrast with the previous experiment, at 23°C. decreased only slightly; the difference in the adults reared at 23° is attributed to the difference in humidity. When adults not more than 24 hours old that had been reared at 23°C. and a saturation deficiency of 5 gm. per cu. m. were kept for two hours at 36°C. [96·8°F.] in a saturated atmosphere and then exposed after 24 hours to 43°C., the period to 50 per cent. mortality was increased to 220 minutes, as compared with 134 minutes for insects not acclimatised at 36°C., the difference being significant.

Prat (H.). **Analyse micro-calorimétrique des variations de la thermogenèse chez divers insectes.**—*Canad. J. Zool.* **32** no. 3 pp. 172–197, 1 pl., 31 figs., 13 refs. Ottawa, 1954. (With a Summary in English.)

The following is based on the author's summary. The curves of thermogenesis (thermograms) of various species of *Melanoplus* obtained by means

of a Calvet microcalorimeter are given and discussed; they are shown to vary among individuals and also with species, sex, age, stage of development and ambient temperature. Under respiratory conditions permitting survival for many days, several types of normal thermogenesis can be distinguished. When the insects were placed in closed cells, their thermograms became strongly modified after a few hours. A strong paroxysm of thermogenesis occurred when the first effects of asphyxia were felt, and it lasted with varying intensity, for two or three hours; then followed a comatose depression leading to death. These effects appear to be due to the accumulation of carbon dioxide, and not to lack of oxygen. In other experiments, performed in the presence of small quantities of sodium hydroxide to absorb the carbon dioxide produced, the insects remained alive for several days, with their thermograms reaching a constant, though slightly undulating, level. The thermogenesis of many other insects, representing species of several orders, was also investigated. Besides specific differences, their thermograms displayed strong variations during moulting, metamorphosis, and oviposition. Microcalorimetry is thus likely to be useful for analysing stages of development as well as physiological responses to environmental factors.

MORRIS (R. F.) & MILLER (C. A.). **The Development of Life Tables for the Spruce Budworm.**—*Canad. J. Zool.* **32** no. 4 pp. 283–301, 1 graph, 21 refs. Ottawa, 1954.

This is the first of a proposed series of papers dealing with techniques for the study of natural populations of *Choristoneura fumiferana* (Clem.) in Canada, and records the way in which life tables similar to those used for human populations were developed for two populations of this insect in north-western New Brunswick. They were based on intensive sampling on two permanent plots of balsam fir (*Abies balsamea*) in 1952–53, complemented by data on fecundity, natural and applied control factors, and dispersion. Life tables for consecutive generations in different types of forest should provide fundamental information on the epidemiology of the species and on the possible reduction of damage through forest management and direct control measures.

MORRIS (R. F.). **A sequential Technique for Spruce Budworm Egg Surveys.** —*Canad. J. Zool.* **32** no. 4 pp. 302–313, 4 graphs, 8 refs. Ottawa, 1954.

This is the second paper in a series dealing with techniques for the study of natural populations of *Choristoneura fumiferana* (Clem.) in Canada [*cf.* preceding abstract]. Surveys of the eggs of *C. fumiferana* in August–September permit the damage expected from larval feeding the following year to be forecast and its distribution to be shown on maps, and the necessary programme for aerial spraying can thus be made in advance. A technique was desirable for the rapid classification of the infestation, at a large number of sampling points, as light, moderate or severe. The limits set for egg populations that conform approximately to these classes of expected defoliation are 25 egg-masses or less per 100 sq. ft. of foliage surface, 50–100, or more than 200, respectively.

The method evolved utilises sequential sampling, in which the sample size is not fixed, but successive samples are taken at each point until the cumulative total of egg-masses is such that, having regard to the number of samples concerned, the infestation can be allotted with a given degree of confidence to a particular class. Superfluous sampling at points where the infestation is definitely light or definitely severe is thus eliminated.

The tree is the major sampling unit, and it is expedient for survey purposes to restrict the universe to one species (usually *Abies balsamea*) and to the dominant and codominant crown classes. The egg population is determined either by felling the tree and counting on sample branches representing different parts of the crown (Method I) or, where the crown can be reached with pole pruners, by cutting one branch from the middle of it (Method II). The distribution of egg populations is of the form of a negative binomial, and by using the properties of this function it is possible to compute a curve of operating characteristics (showing the probability at any population level of accepting a given one of a pair of infestation classes), and a curve of average sample numbers (showing the mean number of trees that must be sampled at any population level in order to discriminate between successive classes of infestation). From these, the probable number of trees that will have to be sampled at different populations can be predicted.

For each of the two sampling methods, graphs are prepared, with number of trees sampled as abscissae and cumulative totals of egg-masses as ordinates, on which parallel diagonals, termed acceptance and rejection lines, enclose a band that separates two classes of infestation. These bands are of such a width that if trees are taken in succession at each sampling point until the cumulative total of egg-masses falls outside the band, the chance of the infestation being allotted thereby to the wrong class is less than 10 per cent. The method was tested on *A. balsamea* in northern New Brunswick in 1953. Field parties were provided with simple tabulations prepared from the acceptance and rejection lines, and with an expenditure of 1,300 man-days, more than 1,000 points were classified.

House (H. L.). **Nutritional Studies with *Pseudosarcophaga affinis* (Fall.), a Dipterous Parasite of the Spruce Budworm, *Choristoneura fumiferana* (Clem.). I. A chemically defined Medium and Aseptic-culture Technique.**—*Canad. J. Zool.* **32** no. 5 pp. 331–341, 2 graphs, 30 refs. Ottawa, 1954. **II. Effects of eleven Vitamins on Growth.**—*T. c.* pp. 342–350, 29 refs. **III. Effects of nineteen Amino Acids on Growth.**—*T. c.* pp. 351–357, 18 refs. **IV. Effects of Ribonucleic Acid, Glutathione, Dextrose, a Salt Mixture, Cholesterol, and Fats.**—*T. c.* pp. 358–365, 32 refs.

The following is taken from the author's summary of the first part of this series. A chemically defined medium, consisting mainly of amino acids, dextrose, salts and vitamins, and an aseptic technique are described for nutritional studies with larvae of *Agria* (*Pseudosarcophaga*) *affinis* (Fall.), a parasite of the spruce budworm, *Choristoneura fumiferana* (Clem.), in Canada. In feeding tests with 542 larvae, micro-organisms contaminated only 3·9 per cent. of the initial number. Within an assay period of 20 days, 83·9 per cent. of the aseptic larvae reared on the medium reached the third instar. After removal from the rearing medium, 59·9 per cent. of the aseptic larvae pupated, and adults emerged. The time required for 50 per cent. of the aseptic larvae to develop to the third instar was 9·2 days. This is the first medium composed, except for the agar, of chemically pure substances, to be successfully used for rearing an entomophagous insect parasite.

In the second part, six of the 11 vitamins tested are shown to be essential for growth and development of the parasite larvae; another exerted slight beneficial effect on pupation, and the omission of an eighth slightly stimulated growth and development. Deficiencies in different vitamins exerted critical effects at different stages of larval development. In the experiments

described in the third part, ten amino acids were found to be necessary for the development of the larvae beyond the first instar, and the absence of four others significantly reduced the rate of growth.

The following is virtually the author's summary of the fourth part. *A. affinis* reared aseptically on chemically defined media requires ribonucleic acid, dextrose, a salt mixture, cholesterol and fats for optimum growth; the differences between the results obtained on the experimental media and on the controls were statistically significant. Glutathione is not required for growth, but possibly aids metamorphosis.

Gannon (N.) & Decker (G. C.). **Insecticide Tests against the Chinch Bug in the Laboratory.**—*J. econ. Ent.* **48** no. 3 pp. 240–242, 4 refs. Menasha, Wis., 1955.

An account is given of laboratory investigations on the relative toxicity of several insecticides to *Blissus leucopterus* (Say) and the persistence of their effect. In tests in which adults were confined for 30 minutes in cartons bearing residues from acetone solutions, deposits of 52 mg. endrin, 104 mg. γ BHC as lindane, 208 mg. aldrin or dieldrin and 416 mg. heptachlor per sq. ft. gave complete mortality, and 52 mg. dieldrin and 208 mg. heptachlor and malathion gave 89, 91 and 96 per cent. kill, respectively, immediately after application, whereas 312 mg. chlordane gave only 60 per cent. and 623 mg. toxaphene practically none; 104 mg. endrin and 208 mg. dieldrin gave practically complete kill up to 14 days after application, and 416 mg. heptachlor or aldrin was only slightly less effective; 208 mg. γ BHC was completely effective for four days, but then decreased in value. All the materials but chlordane and toxaphene gave practically complete kill of insects exposed for six hours 14 days after application.

When the bugs were shaken for 15 minutes in soil treated with the insecticides, mortality counts after 120 hours showed that endrin and parathion were the most toxic, 3, 2, 16, 32, 32 and 96 times as much dieldrin, γ BHC, heptachlor, chlordane, toxaphene and DDT, respectively, being required for comparable kill. The first three gave good kills for 16 days, and the speed of action was generally closely correlated with relative toxicity.

When the insects were confined for 24 hours on treated packed soil, 15 mg. endrin, γ BHC, parathion or dieldrin per sq. ft. gave complete mortality immediately after application, 45 mg. heptachlor or aldrin about 90 per cent. kill and 60 mg. chlordane and toxaphene 68 and 50 per cent. Endrin and parathion gave good control for 13 days and γ BHC for four, but the other materials showed poor residual effect; the persistence of γ BHC and parathion is not consistent with results obtained in the field.

Gannon (N.) & Decker (G. C.). **Field Evaluation of Sprays for Chinch Bug Control.**—*J. econ. Ent.* **48** no. 3 pp. 242–245, 1 ref. Menasha, Wis., 1955.

Wheat fields in central Illinois were seriously damaged in 1954 by large numbers of adults of the chinch bug [*Blissus leucopterus* (Say)] that had flown in from their overwintering quarters, and the resulting nymphs threatened maize in several parts of the State. In further tests of insecticides [*cf. R.A.E.*, A **41** 360], 0·5 lb. dieldrin per acre applied in aeroplane sprays on 17th–22nd May, when the adults became numerous enough to kill wheat, gave control that became evident in 3–7 days and practically

eliminated the bugs in ten days. The newly hatched nymphs died rapidly, and no infestation developed in treated fields. Treatment with 1 lb. dieldrin per acre showed little extra advantage.

Various insecticides were tested later in the season as barrier sprays to protect maize against migrating bugs and showed much the same order of effectiveness against light, moderate or heavy invasions. Against the first, 0·25 lb. endrin, 0·5 lb. dieldrin or parathion and 1 lb. aldrin per acre remained effective for six days, 0·5 lb. γ BHC as lindane was effective for one day only and 2 lb. toxaphene or DDT, 1·5 lb. chlordane and 1 lb. heptachlor had little effect. Against the second, dieldrin, endrin and aldrin were effective for six days, after which the field was cultivated, parathion for three and γ BHC for one, and chlordane, DDT, heptachlor and toxaphene had little effect. Against a heavy invasion that had probably begun two days before spraying, γ BHC and parathion gave some protection for one day, toxaphene at 4 lb. for three days and endrin and dieldrin for six; aldrin, chlordane, DDT and heptachlor were ineffective. Endrin and dieldrin were the only materials that remained effective throughout the period of migration, no bugs that passed the barriers living long enough to damage the untreated maize beyond and the treated plots being free of living bugs 2–3 days after the migration was over. Spraying plots on the border between infested barley and uninfested maize with dieldrin on different days showed that when migration had begun before spraying, large numbers of bugs in protected positions in the plots remained on the plants for a few days, and that in continued heavy migrations some bugs reached the first sprayed rows of maize, but did not survive for more than a day or so or reach the untreated maize beyond.

Bugs below the soil and under leaf sheaths were not counted in these tests, but it was found that plants were generally completely free of infestation within three days after the destruction of the exposed bugs.

Howitt (A. J.) & Bullock (R. M.). **Control of the Garden Centipede.**— *J. econ. Ent.* **48** no. 3 pp. 246–250, 5 figs., 2 refs. Menasha, Wis., 1955.

Scutigerella immaculata (Newp.) caused damage of economic importance in Washington State for the first time in 1953, though it had probably been present there for some time. In experiments in south-western Washington in 1953–54, aldrin and heptachlor in granular form [*cf. R.A.E.*, A **41** 370] applied to the soil with the fertiliser at the rate of 10 lb. actual toxicant per acre in autumn, and toxaphene at 15 lb. and endrin, heptachlor and aldrin at 10 lb. per acre in emulsion concentrates applied in spring before planting failed to protect spring-planted strawberries and raspberries, respectively, and dusting the roots of raspberry or strawberry with 1 per cent. lindane [almost pure γ BHC] before planting killed the plants. When applied to the soil as sprays in 16-inch bands, down the centre of which the seeds of bush beans, maize and radish were sown, a parathion emulsion concentrate at 10 lb. actual toxicant per acre proved outstanding, malathion in an emulsion concentrate and EPN [ethyl p-nitrophenyl thionobenzene-phosphonate] in a wettable powder at the same rate were rather less effective, and isodrin, though the best of the chlorinated compounds tested, was inferior to the phosphates. In a large-scale test, treatment in spring, before cabbages or cauliflowers were planted, with 5 lb. parathion and 10 lb. aldrin per acre, alone or together in emulsion concentrates, resulted in 87, 34 and 93 per cent. normal plants, as compared with 24 per cent. for no treatment, and very greatly increased yields.

Wright (J. M.) & Decker (G. C.). **Laboratory and Field Tests to control Squash Bug.**—*J. econ. Ent.* **48** no. 3 pp. 250–255, 2 figs., 4 refs. Menasha, Wis., 1955.

In view of the lack of a practical and economic method of controlling *Anasa tristis* (Deg.), an important pest of squash and pumpkin throughout the United States, 11 of the newer insecticides were tested against it in Illinois in 1953–54.

In laboratory tests in which acetone solutions were applied topically, parathion and lindane [almost pure γ BHC] gave complete mortality of adults in 72 hours at dosages of 32 and 64 μg. per gm., respectively, aldrin, endrin and EPN [ethyl p-nitrophenyl thionobenzenephosphonate] at 128 μg., and heptachlor, isodrin and dieldrin at 256 μg., dieldrin being slightly less toxic than the other two at lower dosages. Chlordane, toxaphene and DDT were not effective. The speed of action appeared to be in the same order, except that aldrin acted somewhat more rapidly than endrin or EPN; heptachlor appeared to be more rapid than isodrin, but required the same dosage to give 90 per cent. mortality in 72 hours. When adults were exposed to week-old deposits of 100 mg. dieldrin, parathion, γ BHC, heptachlor or aldrin per sq. ft., the first gave complete mortality in 96 hours and the others 0–40 per cent.

In field tests of sprays applied to pumpkin at 20 U.S. gals. per acre on 2nd July, counts of egg-masses on 6th July showed that parathion at 0·3 lb. per acre in a wettable powder and dieldrin, aldrin and endrin at 0·5 lb. in emulsion sprays showed promise, γ BHC at 0·25 lb. in a wettable powder was less effective, and heptachlor at 0·5 lb. in emulsion was useless. When the first three were applied in 34 U.S. gals. spray per acre on 8th July, dieldrin reduced oviposition more and parathion less than aldrin, the abundance of eggs in the parathion plots rising sharply after eight days. Dieldrin was also more effective against the nymphs, aldrin and parathion giving good initial kill but decreasing in effectiveness after eight days. Counts of adults showed only fair control by any of the materials, although the lower numbers of eggs laid in the dieldrin plots would indicate that many were killed. A second application on 14th July only slightly decreased the number of eggs laid, although the numbers of nymphs and adults were reduced, and appeared of doubtful economic value. This conclusion was supported by observations in fields receiving only one application of dieldrin. Where entire fields were sprayed, one application by ground sprayer or aeroplane gave excellent control and resulted in marked increases in yield and quality of fruit.

Bigger (J. H.) & Blanchard (R. A.). **Ecology and Control of Soil Insects attacking Corn in Illinois.**—*J. econ. Ent.* **48** no. 3 pp. 255–260. Menasha, Wis., 1955.

An attempt was made in 1953 and 1954 to evaluate the importance of the soil insects that attack the sown seeds or roots of maize in northern Illinois, and the effectiveness of insecticides against them, by sampling in fields in which strips had been treated and the remainder left untreated and in experimental plots treated with several insecticides. Infestation was moderate, the main pests present being wireworms of the genera *Melanotus* and *Conoderus*, white grubs (larvae of the genera *Lachnosterna* (*Phyllophaga*) and *Cyclocephala*) and the northern corn rootworm [*Diabrotica longicornis* (Say)]. No other single species was abundant, but combinations of 2–7 injurious species were observed in half of the 46 fields in which untreated areas were sampled.

The following is based on the authors' summary of the control observations. When various insecticides were applied to the soil as sprays or with fertiliser before sowing, and disked in, aldrin or heptachlor at 1·5 lb. per acre apparently controlled the most injurious insects present; 1 lb. per acre was sufficient against *D. longicornis*. Dieldrin at 1 lb. was effective against the wireworms and *Lachnosterna*, and endrin and lindane [almost pure γ BHC] at 0·5 lb. against the wireworms. Increases in numbers of plants were equal where aldrin and heptachlor were applied at equal rates, and the method of application seemed unimportant, provided that the insecticide was covered immediately afterwards. Treatment of the seeds with 8 oz. γ BHC per bushel gave no control and usually reduced the numbers of plants. Soil treatment resulted in increases in yield in most fields, but yield losses were associated with treatment in some very dry areas, probably owing to the presence of more plants than the available moisture would support.

Gannon (N.) & Decker (G. C.). **Organic Insecticides as Sprays for Armyworm Control.**—*J. econ. Ent.* **48** no. 3 pp. 260–262, 6 refs. Menasha, Wis., 1955.

In tests against *Pseudaletia unipuncta* (Haw.) in Illinois, sprays were applied to wheat in 1953 and meadow foxtail [*Alopecurus pratensis*] in 1954 at 25 U.S. gals. per acre by means of six nozzles along a 12-ft. boom, and reductions in population were estimated by counting the numbers dead among the first 25 larvae found at sample points at intervals after treatment and by sweeping with a net when the larvae were feeding on the foliage at night and calculating the number per sweep. Both methods of estimation showed good control by toxaphene at 1–2 lb. per acre, dieldrin at about 0·25 lb. and endrin at 0·15–0·25 lb. and poor to fair control by 0·25–0·5 lb. parathion or 1 lb. γ BHC; the first method showed poor but the second good control by 1·5 lb. DDT or chlordane and 2 lb. methoxy-DDT (methoxychlor), probably because larvae receiving sublethal doses ceased feeding for a time but later resumed and pupated normally [*cf. R.A.E.*, A **39** 387]. In spite of probable immigration from untreated plots, endrin, dieldrin and toxaphene continued to reduce larval numbers considerably for 13 days after treatment at points 16–24 ft. from sources of migration and gave fair reduction 8–16 ft. from them, suggesting that sprays applied in barrier strips might effectively protect young maize bordering infested small grains or pasture. Chemical analysis of the wheat straw about a month after treatment showed residues varying from 1·3–3·7 parts per million for dieldrin and 0·7–7·4 for endrin to 8·8–45·7 for DDT; no residues were found on the threshed wheat. Treated meadows produced almost 2½ times as much cut grass as untreated areas.

Corliss (J. M.). **Damage to our Forests caused by the Gypsy Moth in 1953.**—*J. econ. Ent.* **48** no. 3 pp. 263–264. Menasha, Wis., 1955.

An increase in the area over which forest trees were defoliated by *Lymantria* (*Porthetria*) *dispar* (L.) in the north-eastern United States from 21,314 acres in 1951 to 293,052 acres in 1952 and unusually abundant egg deposition in 1952 were followed by an unprecedented increase in infestation in 1953, when trees over nearly 1½ million acres were 75–100 per cent. defoliated in the late spring and early summer. The States affected were New York, Connecticut, Vermont, Maine and, notably, New Hampshire and Massachusetts, and the degree and distribution of the defoliation is discussed.

Records for the past 25 years show that peaks of defoliation have occurred at about eight-year intervals, and this is thought to be due, at least partly, to climatic conditions and control by natural enemies. Defoliation has

caused heavy mortality and retardation of growth of trees over large areas; in some localities, 3–50 per cent. of the oaks have been killed, and mortality of young white pines [*Pinus strobus*] has been substantial in many areas in which they occurred in mixed stands. Retardation in growth has been shown to be directly proportional to the degree of defoliation, and complete defoliation in two successive years, or sometimes in one only, is fatal to softwoods, notably hemlock [*Tsuga*]. Intangible losses from deterioration of forest stands and the general harmful effect on future productive capacity are even more important.

The situation in 1953 was complicated by the occurrence on 9th June of two devastating tornadoes in Massachusetts and one in New Hampshire. As one of them originated in areas of heavy infestation when most of the larvae were in the third instar, it is possible that larvae may have been dispersed to distant points, though there is some doubt whether they could survive in currents of air that travelled at up to 350 miles per hour and ascended to nearly 60,000 ft., where the temperature is below freezing-point. In two areas in which extensive and successful spraying had been carried out in 1949 and 1950, moths were caught at numerous points in July and August, and it is not known whether these resulted from the phenomenal increase of the insect in 1952 and 1953 or from larvae dispersed by the tornadoes.

HARTLEY (J. B.) & BROWN (A. W. A.). **The Effects of certain Insecticides on the Cholinesterase of the American Cockroach.**—*J. econ. Ent.* **48** no. 3 pp. 265–269, 3 graphs, 13 refs. Menasha, Wis., 1955.

The effect *in vitro* of 32 insecticidal compounds on cholinesterase from the head of the American cockroach (*Periplaneta americana* (L.)) was tested by two manometric methods, which are described. Those that had no effect at a molar concentration of 10^{-3} were DDT [*cf. R.A.E.*, A **38** 233], DDD, methoxy-DDT (methoxychlor), technical BHC, γ BHC (lindane), α-chlordane, β-chlordane, heptachlor, aldrin, isodrin, dieldrin, endrin, toxaphene, DNC, dinex, dinoseb, pyrethrins, allethrin, rotenone, sabadilla, ryania, phenothiazine, β-butoxy β'-thiocyanodiethyl ether (from Lethane 384), schradan and EPN [ethyl p-nitrophenyl thionobenzenephosphonate] [*cf.* **39** 175; **42** 152]. Pyrolan [1-phenyl-3-methyl-5-pyrazolyl dimethylcarbamate] [*cf.* **42** 153] and purified but old samples of parathion and malathion [*cf.* **41** 358; **43** 37] were inhibitory at 10^{-3} and Diazinon [O,O-diethyl O-2-isopropyl 4-methyl-6-pyrimidinyl thiophosphate] [*cf.* **41** 399] and TEPP [tetraethyl pyrophosphate] at 10^{-3} and 10^{-5}. Nicotine was partly inhibitory at 10^{-3} but not at 10^{-5}. The active principle of Lethane 60 (β-thiocyanoethyl laurate) appeared to increase cholinesterase activity, but the increased volume of carbon dioxide evolved did not in fact arise from the acetylcholine substrate.

MILLIRON (H. E.) & MACCREARY (D.). **The Alfalfa Weevil in Delaware, 1953–54.**—*J. econ. Ent.* **48** no. 3 pp. 283–289, 4 figs., 8 refs. Menasha, Wis., 1955.

Hypera variabilis (Hbst.) (*postica* (Gylh.)), which attacks lucerne, was observed in Delaware for the first time in April 1952 and spread rapidly through the State. Observations on its bionomics in 1953 and 1954 showed that the winter was passed mainly in the adult stage, but that the eggs and possibly the larvae also overwinter. Overwintered adults began to oviposit in early March and were still present in small numbers towards the end of the season. Adults from overwintered eggs began to appear in early April, and others, apparently from eggs deposited in early spring,

in late April or early May; they continued to appear until very late autumn. Newly emerged females require a diapause before ovipositing, and probably few produce eggs in the year in which they emerge. The larval population reached a peak in late April or early May and increased again slightly in August–October, probably owing to the appearance of offspring of adults from both overwintered and spring eggs.

The weevil was not generally destructive to lucerne in Delaware until 1954. The heaviest damage occurred on the first growth in May and was usually confined to fields two or more years old that had been infested previously. Lucerne less than a year old was not injured in spring unless it was adjacent to heavily infested older plantings. Adults began to disperse to the young lucerne from June onwards, and conditions in the young fields during summer and autumn, irrespective of cutting dates, favoured the production of late-season larvae.

In tests on control, single applications of 4 oz. dieldrin in 25 U.S. gals. emulsion spray per acre on 28th March 1953 and of 4 oz. dieldrin or heptachlor in 33 U.S. gals. on 7th April 1954 gave good protection to the first growth, but toxaphene sprays were not satisfactory. The addition of malathion for the control of the pea Aphid [*Macrosiphum pisum* (Harris)] appeared to reduce the effectiveness of dieldrin and heptachlor, but increased that of toxaphene. No treatment was necessary on the second growth, and yields were virtually proportional to the degree of control attained.

In view of the absence of effective natural enemies of the weevil, adults of the Ichneumonid, *Bathyplectes curculionis* (Thomson), which parasitises it, were liberated near Bridgeville in May 1954; it is not known whether establishment resulted. The fungus, *Beauveria globulifera*, attacked all stages and caused heavy mortality in both field and laboratory in 1953, but was relatively unimportant in 1954.

TRIPLEHORN (C. A.). **The Asiatic Oak Weevil in Delaware.**—*J. econ. Ent.* **48** no. 3 pp. 289–293, 6 figs., 13 refs. Menasha, Wis., 1955. **Erratum.**—*T. c.* no. 4 p. 488.

Cyrtepistomus castaneus (Roel.), which was originally described from Japan, was found in New Jersey in 1933, subsequently spread to Maryland, Virginia, West Virginia and Pennsylvania, and was taken in Delaware in 1950. It mainly attacks oaks in the United States, particularly seedlings, but also injures other forest trees, a list of which is given. Observations on its bionomics in Delaware in 1953–54 showed that the weevil has only one generation a year, probably overwintering as a young larva. The larvae were observed to be closely associated with the roots of seedling oaks in April and May, but their feeding habits are unknown. They pupate about mid-June, and the adults emerge in numbers about a week later and feed on the leaves, causing serious defoliation. No males were found, and females that emerged from pupae in the laboratory oviposited 13–18 days later, in July. All stages are described.

IVY (E. E.), BRAZZEL (J. R.), SCALES (A. L.) & MARTIN (D. F.). **Two new Phosphate Insecticides for Cotton Insect Control.**—*J. econ. Ent.* **48** no. 3 pp. 293–295, 5 refs. Menasha, Wis., 1955.

Two new insecticides, Bayer 16259 and Bayer 17147, defined as benzotriazine derivatives of an ethyl and a methyl dithiophosphate, respectively, were tested against pests of cotton in Texas in 1953–54. In field-cage tests in 1953, sprays containing 16259 were applied at 15 U.S. gals. per acre against adults of *Anthonomus grandis* Boh. in June, when the weevils

were relatively easy to kill with insecticides, and in October, when they were very resistant [*cf. R.A.E.*, A **40** 113]. Dosages of 0·5 and 1 lb. actual compound per acre gave 97 and 100 per cent. kill in June, and 1 and 2 lb. gave 74 and 96 per cent. in October, as compared with 66 per cent. kill for 2 lb. toxaphene in June and 54 for 4 lb. in October.

In 1954, 16259 and 17147 were compared in sprays with a standard insecticide (toxaphene, parathion or DDT) against various cotton pests in the laboratory and in field cages. They gave 90 and 100 per cent. mortality, respectively, of *A. grandis* at 0·25 lb. per acre, as compared with 86 per cent. for toxaphene at 2 lb., 100 and 75 per cent. kill of *Aphis gossypii* Glov. at 0·125 lb., as compared with 84 per cent. for 0·125 lb. parathion, 100 and 71 per cent. kill of *Tetranychus tumidus* Banks at 0·062 lb., as compared with 92 per cent. for 0·125 lb. parathion, 96–100 per cent. kill of larvae of *Alabama argillacea* (Hb.) at 0·5–1 lb., as compared with 45 per cent. for toxaphene at 2 lb. and 100 per cent. for parathion at 0·25 lb., and 74 and 15 per cent. kill of larvae of *Estigmene acraea* (Dru.) at 1 lb. and 23 and 12 per cent. at 0·25 lb., as compared with 30 per cent. for parathion at 0·25 lb. In addition, 17147 gave 90–92 per cent. kill of larvae of *Heliothis zea* (Boddie) (*armigera*, auct.) at 1–2 lb., as compared with 58 for 2 lb. toxaphene, complete kill of *Acontia dacia* Druce [*cf.* **43** 431] at 0·5 lb., toxaphene at 2 lb. giving the same result, complete kill of *Frankliniella tritici* (Fitch) and *Psallus seriatus* (Reut.) at 0·25 lb., as compared with 6 and 100 per cent., respectively, for toxaphene at the same rate, and 64 per cent. kill of larvae of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) at 1 lb., as compared with 55 per cent. for DDT at 4 lb. Since field control of *P. gossypiella* by DDT is probably due in part to mortality of the adults, adults were released on plants sprayed with 17147 in the laboratory; complete mortality resulted in a few hours.

In a field-cage test of residual toxicity against *Anthonomus grandis* at a time when the daily maximum temperature usually exceeded 90°F., 17147 at 1, 0·5 and 0·25 lb. per acre gave 100, 89 and 87 per cent. mortality immediately after application, 61, 44 and 49 per cent. after three days and 48, 14 and 12 per cent. after five days, as compared with 57, 16 and 15, respectively, for 2 lb. toxaphene; at lower temperatures, 0·25 lb. 17147 was effective for 5–7 days.

In field tests against a heavy infestation of *P. gossypiella*, dusts of 10 or 20 per cent. DDT or 5 per cent. 17147 were applied at 15 lb. per acre on 10th September, when 6–7 per cent. of the flowers were rosetted, and again six times at intervals of about five days, until infestation was less than 1 per cent. Weekly counts of injured bolls and the numbers of larvae per 100 bolls from 16th September to 15th October and yield records made in November showed significantly better results for 17147 than for DDT, which was no better than no treatment. There were no differences in grade or staple of the cotton. Increases in *Aphis gossypii* on plots receiving DDT or no treatment resulted in pronounced yellowing of the leaves, whereas foliage treated with 17147 remained green, luxuriant and free from the Aphid; Aphid control with this compound may have contributed to the increased yield.

REYNOLDS (H. T.), ANDERSON (L. D.) & DEAL (A. S.). **The Egyptian Alfalfa Weevil and its control in southern California.**—*J. econ. Ent.* **48** no. 3 pp. 297–300, 11 refs. Menasha, Wis., 1955.

The following is based on the authors' summary. The introduced *Hypera brunneipennis* (Boh.) [*cf. R.A.E.*, A **41** 277, etc.] spread rapidly over much of southern California after 1949. It damages lucerne and clover in both

hot arid areas and relatively cool humid ones, and although its ecological limitations are not known, it seriously threatens the large areas under these two crops in California.

Preliminary studies showed that the life-history and habits of this weevil resemble those of the more northerly *H. variabilis* (Hbst.) (*postica* (Gylh.)). The adults aestivate, and appear in the lucerne fields in December. The larvae are most abundant from February to April. Damage to the growing tips of the plants is severe, and when the larvae are abundant, they skeletonise lucerne over large areas.

Both larvae and adults appear to be highly susceptible to insecticides. In sprays, applied to growing lucerne at 22–32 U.S. gals. per acre by means of power sprayers in March 1952, February 1953 and March 1954, heptachlor and aldrin at 1 oz., chlordane at 0·5 lb. and Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)], methoxy-DDT (methoxychlor) and Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] at 1 lb. per acre gave excellent control of the larvae. DDT and toxaphene at 1 lb. and lindane [almost pure γ BHC] at 0·25 lb. were somewhat less effective. EPN [ethyl p-nitrophenyl thionobenzenephosphonate] and methyl-parathion at 0·25 lb. per acre were the most promising of the phosphates tested and somewhat superior to parathion and Metacide [a mixture of methyl-parathion and parathion] at 0·25 lb. and malathion at 0·5–0·75 lb. per acre. NPD [tetra-n-propyl dithionopyrophosphate] at 0·72 lb. gave poor results.

When sprays were applied to lucerne stubble on 21st February 1953 at rates of 24–31 U.S. gals. per acre with a power sprayer, to kill the adults before they oviposited, counts of larvae on 24th March showed that 0·43 lb. heptachlor, 0·21 lb. dieldrin and 0·4 lb. aldrin per acre gave reductions in population of 93–98 per cent., as compared with no treatment, and 2·7 lb. toxaphene, 0·24 lb. endrin, 0·53 lb. γ BHC and 0·89 lb. chlordane gave 84·5–89 per cent. DDT at 1·4 lb., ethyl-DDD at 1·14 lb. and EPN at 0·4 lb. gave fair or poor results.

Richardson (B. H.) & Wene (G. P.). **Control of the Onion Thrips in South Texas in 1954.**—*J. econ. Ent.* **48** no. 3 pp. 310–311, 3 refs. Menasha, Wis., 1955.

In further tests in 1954 of the insecticides now recommended for the control of *Thrips tabaci* Lind. on onion in the Winter Garden area of Texas [*cf. R.A.E.*, A **43** 240, etc.], ground applications of 0·2 lb. parathion, 0·625 lb. malathion and a mixture of 0·3 lb. BHC and 0·5 lb. DDT in 25 U.S. gals. spray per acre gave 75–87 per cent. reduction in infestation one and eight days after application, as compared with no treatment, and were considerably more effective than 0·1 lb. methyl-parathion, 0·25 lb. dieldrin, 0·5 lb. aldrin or heptachlor or 2 lb. toxaphene. Aeroplane application of 0·38 lb. parathion and of 0·25 lb. parathion with 0·25 lb. heptachlor or aldrin or with 0·19 lb. dieldrin in 4 U.S. gals. water per acre gave commercial control, whereas 0·5 lb. heptachlor, 0·28 lb. dieldrin and a mixture of half these quantities were ineffective. In tests of the number of applications necessary, three applications of 0·5 lb. dieldrin per acre at intervals of 7 or 14 days or two at an interval of 21 days were equally effective but significantly less so than five at weekly intervals.

Three experiments were carried out in the Lower Rio Grande Valley, in which sprays were applied at 100 U.S. gals. per acre with a small garden sprayer. The results showed that 0·2 lb. dieldrin, 2 lb. toxaphene, 0·25 lb. methyl-parathion and 0·5 lb. Pyrazoxon [diethyl 3-methyl-5-pyrazolyl phosphate] gave good commercial control for eight days, 0·6 lb. malathion,

0·25 lb. parathion and a mixture of 0·22 lb. BHC and 0·38 lb. DDT gave satisfactory control for four days, and 0·1 lb. endrin and 0·25 lb. lindane [almost pure γ BHC] or Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] gave good immediate control but lost much of their effectiveness in four days.

Comparison of results in the two localities showed that dieldrin, toxaphene and methyl-parathion were effective in the Lower Rio Grande Valley but no longer so in the other area [*cf.* **41** 267; **43** 240] and that parathion, though effective in both areas, lost its effect sooner in the former.

Steiner (L. F.) & Lee (R. K. S.). **Large-area Tests of a Male-annihilation Method for Oriental Fruit Fly Control.**—*J. econ. Ent.* **48** no. 3 pp. 311–317, 3 figs., 2 refs. Menasha, Wis., 1955.

In view of the finding in Hawaii that methyl eugenol is exceedingly attractive to the males of *Dacus dorsalis* Hend. and the favourable results of a preliminary test on the control of this fruit-fly by means of parathion-treated traps baited with it [*cf. R.A.E.*, A **40** 230–231], three experiments were carried out in 1950–53. The following is based on the authors' summary of the work.

In the first experiment, which was carried out on Oahu, in a 1½-mile section of a deep gulch with an abundance of wild host fruits, 45–55 box-type traps, treated with methyl eugenol and a parathion slurry or methyl eugenol with Pyrolan [1-phenyl-3-methyl-5-pyrazolyl dimethyl-carbamate] dissolved in it, attracted and killed more than three million males of *D. dorsalis* over a period of 28 months. Mean infestations in four successive guava crops averaged 1·2–4·2 larvae per lb. fruit in the treated gulch and 7·1–35 per lb. in similar untreated ones. The two later tests were carried out on the island of Hawaii, and the box traps were replaced by fully exposed 10-in. squares of unpainted cane-fibre insulation board treated monthly with 25–30 cc. methyl eugenol containing 3 per cent. Pyrolan, which had been found just as effective. On the Hamakua coast, an area of six sq. miles sloping up a mountain was protected for 16 months by means of 165–215 such lures. There was no control at an elevation of 300 ft. along the coast, where onshore winds prevented adequate dispersal of the attractive odours, but at 700, 1,100, 1,500 and 1,900 ft. above sea level, the mean infestations in guava fruits were 74, 70, 82 and 60 per cent. less, respectively, than at similar elevations in the untreated area and complete control was obtained over several monthly periods. The infestation rapidly increased again at each elevation after the end of the experiment. Except for the first month after their installation and for a two-month period of widespread fruit-fly movement, the lures kept the central part of the treated area almost devoid of males. The treatment did not affect parasitism of the larvae by *Opius oophilus* Fullaway, which reached about 60 per cent., but suppression of *D. dorsalis* resulted in marked increases in *Ceratitis capitata* (Wied.) during the summer.

In the third experiment, in a small semi-isolated stand of guava on the slopes of another mountain, satisfactory control of *D. dorsalis* was not obtained, because of migration of fertilised females into the treated area. A single trap in a neighbouring area devoid of host fruits caught 178,000 males during the 16 months of the experiment and provided striking evidence of the normal movement of the fruit-flies, which is entirely independent of the availability of fruits. It is concluded that successful use of the method for control purposes will probably be restricted to areas in which entire isolated populations can be treated or to commercial fruit-growing areas in which wild host fruits are of little importance.

Wilson (M. C.), Davis (R. L.) & Williams (G. G.). **Multiple Effects of Leafhopper Infestation on irrigated and non-irrigated Alfalfa.**—*J. econ. Ent.* **48** no. 3 pp. 323–326, 1 fig., 11 refs. Menasha, Wis., 1955.

Damage to lucerne by comparatively heavy infestations of *Empoasca fabae* Harris in Indiana has for several years been more severe on sandy soils with a low water-holding capacity than on heavy soils, and investigations were carried out to compare the effect of infestation on plants in a dry soil that received adequate water through overhead irrigation and similar ones that were not irrigated. Lucerne of various varieties was sown in 1952, and some of the plots received 6·5 ins. water in six irrigations between June and August in 1953, when the rainfall in May–September totalled 17·13 ins. Methoxy-DDT (methoxychlor) was applied at 1 lb. per acre in a spray to the third cutting in this year to control leafhopper on part of each plot, and resulted in 21 and 49 per cent. increase in growth (plant height) on irrigated and non-irrigated plots, respectively, within two weeks. Comparison of the nine varieties used showed variations in reaction to infestation, one variety being relatively tolerant of it when water was adequate and another giving low yields when infested, regardless of available water. Leafhopper control resulted in rapid recovery of the crop after cutting, with no difference due to irrigation; the nine varieties averaged 45 per cent. more growth two weeks after cutting on treated than on untreated plots. Irrigation in 1953 caused less than 3 per cent. increase in growth in the nine varieties by 6th May 1954, whereas leafhopper control in 1953 resulted in 18 per cent. more growth by that date and a third of a ton more hay per acre at the first cutting on 1st June. Damage by the spittlebug [*Philaenus leucophthalmus* (L.)] in 1954 was significantly lower on the more vigorous plots resulting from leafhopper control in 1953.

Haviland (E. E.) & Highland (H. A.). **The Phytotoxicity of Malathion to Poinsettias.**—*J. econ. Ent.* **48** no. 3 p. 326. Menasha, Wis., 1955.

Malathion is not normally injurious to greenhouse plants, but late in 1953 and 1954, emulsion sprays containing 0·1–0·2 per cent. malathion, which gave good control of mealybugs on *Poinsettia* just before or during flowering, were found to injure the leaves and coloured bracts, causing curling, yellowing and dropping, and higher concentrations proved progressively more harmful. Sprays prepared from wettable powders caused less injury, but were undesirable because they left a persistent and unsightly residue.

Taylor (E. A.). **Cantaloup Production increased with Honey Bees.**—*J. econ. Ent.* **48** no. 3 p. 327, 1 ref. Menasha, Wis., 1955.

A further instance is cited of the value of honey bees in pollinating cantaloupe melons in the Salt River Valley of Arizona [*cf. R.A.E.*, A **40** 168].

York (G. T.). **Notes on Parasitization of Grasshoppers by Nemestrinids.**—*J. econ. Ent.* **48** no. 3 p. 328, 1 ref. Menasha, Wis., 1955.

In further observations on parasitism of grasshoppers by *Trichopsidea clausa* (O.-S.) and *Neorhynchocephalus sackeni* (Will.) in Montana [*cf. R.A.E.*, A **40** 164], 6–56 per cent. of the males and 36–97 per cent. of the females of *Metator pardalinus* (Sauss.) were found to be parasitised by these Nemestrinids in the south-east of the State on 2nd–3rd August 1951, and

0–44 per cent. of the males and 0–76 per cent. of the females of *Ageneotettix deorum* (Scud.) by *N. sackeni* in north-central Montana between 23rd July and 11th September 1952.

Scott (L. B.). **Corn Root Webworm ceases to be a Pest of Tobacco in Tennessee.**—*J. econ. Ent.* **48** no. 3 p. 328, 1 ref. Menasha, Wis., 1955.

Crambus caliginosellus Clem. caused severe injury to tobacco seedlings in north-central Tennessee each year until 1940 [*cf. R.A.E.*, A **27** 652], especially where the tobacco was planted on ground that had been left under weeds for several years; large numbers of larvae became established on the roots of the weeds and moved to the tobacco when the weeds were destroyed. No injury has been observed since 1943, however, apparently owing to a change in agricultural practice accompanying an increase in the numbers of beef and dairy cattle. Much of the land used for pasture was occupied by weeds that harboured larvae of *Crambus*. The weeds were eaten by the cattle, and the practice of clipping pastures and fallow land, introduced at about the same time, also resulted in the destruction of many wild food-plants.

Asquith (D.). **Acaricide Tests on Apple in 1954.**—*J. econ. Ent.* **48** no. 3 pp. 329–330, 1 ref. Menasha, Wis., 1955.

In tests to compare acaricides for the control of *Tetranychus telarius* (L.) and *T. schoenei* McG. on apple in Pennsylvania in 1954, dilute sprays were applied to the run-off point (about 12 U.S. gals. per tree), and sprays containing three times the normal concentration of toxicant at 3 U.S. gals. per tree per application. DDT, DDD (TDE) and a fungicide were applied to all trees at appropriate times.

The first application of acaricide was made on 1st or 2nd July, except in the case of F.W.293 (a wettable powder containing 25 per cent. 4,4′-dichloro-α-trichloromethylbenzhydrol), which was applied in a dilute spray at 2 lb. per 100 U.S. gals. on 6th July, and counts on 12th July showed that only this compound gave a good reduction in mite numbers, as compared with no treatment, possibly because of the lateness of its application. A second spray of each material was applied on 13th July, and counts on 6th–10th August showed excellent control for concentrated sprays of 6 lb. 15 per cent. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and of 4·5 lb. Aramite Exp. (15 per cent. Aramite mixed with talc instead of clay) in the first spray and 6 lb. in the second, and satisfactory control from 6 lb. 25 per cent. Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] and from 1 U.S. pint 25 per cent. Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate (demeton)]; a single application of the Systox spray on 2nd July was ineffective. Of the dilute sprays, F.W.293 was outstanding in residual effect, and 0·5 U.S. pint 25 per cent. Systox gave excellent control. The Aramite formulations and F.W.293 were still effective on 24th–25th August, although there was 1·75 ins. rain during July and 5·28 ins. in the first 25 days of August. Chemical analysis of apples picked on 11th October from all the Systox plots showed no detectable residue.

Hopkins (L.). **Food Preferences of the Khapra Beetle.**—*J. econ. Ent.* **48** no. 3 pp. 332–333. Menasha, Wis., 1955.

In the summer of 1954, *Trogoderma granarium* Everts, which has been reported in the United States from California [*R.A.E.*, A **42** 333] and New Mexico, was found infesting mills and grain elevators in six counties of

Arizona. In a test of the food preferences of the Dermestid, batches of 50 larvae were provided with 25 kinds of processed and unprocessed stored products to determine the extent of survival and development into adults. Development was most rapid on maize meal, wheat flour and rolled oats and least so on raisins, unshelled groundnuts, castor beans [*Ricinus communis*], wheat, cottonseed and wool yarn, with no adult emergence in 167 days in the case of the last three. Processed or milled materials were more favourable than their unprocessed counterparts; three times as many adults developed in maize meal as in whole maize, emergence beginning in 28 and 36 days, respectively, and the same trend was evident in comparisons between other milled and whole grains. In stores, the beetle appeared to prefer cracked grain or grain dust to sound grain, but it was observed that when an infestation had begun in the former, the larvae readily attacked and eventually destroyed a large part of the sound grain.

PUTMAN (W. L.). **Effect on the Green Peach Aphid of Sprays of DDT against the Oriental Fruit Moth.**—*J. econ. Ent.* **48** no. 3 p. 333, 1 ref. Menasha, Wis., 1955.

Counts of *Myzus persicae* (Sulz.) on peach trees in the Niagara Peninsula of Ontario that had received sprays of 1–2 lb. 50 per cent. wettable DDT per 100 gals. (with sulphur) for the control of *Cydia* (*Grapholitha*) *molesta* (Busck) in late August in 1946, 1947 and 1949–53 showed that both the numbers of eggs per foot of twig in December and the numbers of Aphids per 100 leaves in the following May or early June were significantly lower than on similar trees that had received sulphur only [*cf. R.A.E.*, A **36** 92]. The Aphid is seldom of economic importance on peach in this district, but DDT applied for the control of *C. molesta* on late varieties might reduce infestation where it is more injurious.

RAWLINS (W. A.). *Rhizoglyphus solani*, **a Pest of Onions.**—*J. econ. Ent.* **48** no. 3 p. 334, 3 figs., 1 ref. Menasha, Wis., 1955.

A wilting of onion seedlings in muckland areas of New York in early 1953 was found to be caused by mites identified as *Rhizoglyphus solani* Oudm., which cut off the roots at the stem bases. Plants escaping serious damage in infested areas grew normally until the bulbs were forming, when the mites congregated at the base and severed the roots near the bulb, as a result of which the plants tipped over and the bulbs ceased to grow. Such injury had previously been attributed to *Hylemyia antiqua* (Mg.).

TURNER jr. (E. C.). *Calendra parvula* **(Gyll.), a Pest of Orchard Grass.**—*J. econ. Ent.* **48** no. 3 p. 335, 5 refs., Menasha, Wis., 1955.

Losses of *Dactylis glomerata*, a valuable pasture grass and seed-producing plant in Virginia, were found in the late summer of 1953 to be due to cutting and tunnelling of the stems and roots in the region of the crown by *Sphenophorus* (*Calendra*) *parvulus* Gylh. [*cf. R.A.E.*, A **30** 228]. Adults of this weevil were observed on the grass in early June 1954, and larvae in the first and second instars in the stems in late June. Larval feeding in the lower stems and roots had begun three weeks later, and full-grown larvae, pupae and adults were numerous in early August but had all disappeared by early September. Previous accounts and field observations indicated that *S. parvulus* probably overwinters as an adult in woodland and oviposits in the grass stems just above the roots in early summer; the eggs hatch in June and the larvae feed in the grass until early August and

pupate in the clumps. The adults emerge about nine days later and leave the plants soon after. There is probably only one generation a year.

WADLEY (F. M.). **Adaptation of Dosage-Mortality Curves to Machine Calculation.**—*J. econ. Ent.* **48** no. 3 pp. 335–336, 4 refs. Menasha, Wis., 1955.

The sigmoid dosage-mortality curve is of great importance in evaluating the results of biological assay, and mathematical methods of high efficiency have been developed for obtaining equations for it. These, however, take much time, and the author describes a method by which they can be adapted for calculation on a small electronic data-processing machine with punched-card input. A provisional equation, which is obtained by plotting several sets of values on one diagram, concentrations, the numbers of subjects treated and the numbers succumbing are the only values required for the punched cards.

Conversion of concentration to logarithms and percentage mortality to logits, here defined as $\log_e(p/q)$, where p is proportion of mortality and $q = 1 - p$ [*cf. R.A.E.*, A **43** 407], appeared to be more adapted to programming for electronic calculators than conversion to logarithms and probits [*cf.* **22** 440]. An example is given to show the use of the former, and modifications necessary for the more involved probit calculation are noted.

DANIELS (N. E.). **Insects affecting Alfalfa Seed Production.**—*J. econ. Ent.* **48** no. 3 pp. 339–340. Menasha, Wis., 1955.

In a preliminary test in the summer of 1954 on the effect of controlling *Frankliniella occidentalis* (Perg.), *Lygus lineolaris* (P. de B.) and the leaf-hoppers, *Aceratagallia uhleri* (Van D.) and *Scaphytopius acutus* (Say), on the production of lucerne seed in Texas, untreated plots and those sprayed in July 1–4 times with 2 lb. toxaphene in 5 U.S. gals. emulsion spray per acre at intervals of 7–11 days showed averages, respectively, of 24·8 and 2–10·3 *Lygus* and 35·6 and 19·6–29 leafhoppers per 100 sweeps of a collecting net and 157·6 and 51·5–106·8 thrips per 36 flowers. Pollinating bees were not affected. Pest populations were light and control generally unsatisfactory; 1–3 applications resulted in 2·7–9·2 per cent. gain in seed yield and four in 22·8 per cent., but it is considered that increases would have been much greater if *Lygus* populations had been heavier. The test was carried out on land considered better than the average for the neighbourhood; a similar test on less productive land resulted in no increase in yield due to insect control.

MICHELBACHER (A. E.) & HITCHCOCK (S.). **Outbreak of the Filbertworm on Walnuts in northern California.**—*J. econ. Ent.* **48** no. 3 pp. 340–341, 1 graph, 1 ref. Menasha, Wis., 1955.

Cydia (*Melissopus*) *latiferreana* (Wlsm.) was destructive to walnuts in the Sacramento Valley of California in 1943–44 and again in 1954, but mostly not of economic importance in the intermediate years. Investigations begun in 1942 showed that the larvae cannot penetrate sound walnut husks, so that infestation does not occur until the husks begin to crack in late August and September. The larvae were found to penetrate the cracks and enter the nut itself through the stem end, with the result that infestation could not be detected from without; the seriousness of the infestation increased as the season advanced and reached 30 per cent. or more in the

harvested crop. Adults are found in the walnut orchards during most of the growing season, and those that develop in the galls of a Cynipid on oak [*cf. R.A.E.*, A **31** 107–108] are the principal source of infestation in walnuts.

Freitag (J. H.), Frazier (N. W.) & Huffaker (C. B.). **Crossbreeding Beet Leafhoppers from California and French Morocco.**—*J. econ. Ent.* **48** no. 3 pp. 341–342, 5 refs. Menasha, Wis., 1955.

Since the species of *Circulifer* identified as *C. tenellus* (Baker) in recent surveys in the Mediterranean basin [*cf. R.A.E.*, A **42** 77–78] was apparently not found on sugar beet there, doubt existed as to its identity with *C. tenellus* of the United States. Parasite studies indicated a close relation [*cf.* **43** 312], and when males from Morocco were sent by air express to California, they failed to infect healthy sugar-beet plants with curly-top virus, indicating that they were not carrying the virus under natural conditions in Morocco, but when fed on infected plants for two days and transferred to healthy seedlings, they transmitted the virus to these. The males paired with females of Californian *C. tenellus*, and the F_1 generation was fertile and also transmitted the virus from infected to healthy sugar beet. It is concluded that only one species is concerned and that *C. tenellus* is a native of the Mediterranean region, whereas the curly-top virus is native to the western hemisphere.

Brett (C. H.) & Brubaker (R. W.). **Rotenone Resistance in the Mexican Bean Beetle.**—*J. econ. Ent.* **48** no. 3 p. 343, 2 refs. Menasha, Wis., 1955.

Comparison of the control of the Mexican bean beetle [*Epilachna varivestis* Muls.] obtained with 0·75–1 per cent. rotenone dusts applied to beans at 20–25 lb. per acre in the mountains of North Carolina and at Norfolk, Virginia, showed considerably poorer results in the former in 1951, 1953 and 1954, and laboratory comparisons of third- and fourth-instar larvae from the two districts were made in 1954. Larvae from Virginia and North Carolina dusted with 0·25–1 per cent. rotenone and transferred to untreated plants after five minutes showed 68–100 and 12–52 per cent. mortality, respectively, after 48 hours, and untreated larvae put on plants that had been dipped in 0·02–0·08 per cent. rotenone emulsion and dried showed 22–38 and 6–18 per cent., respectively. Larvae collected in Virginia and larvae of the third generation reared in the laboratory from beetles collected in North Carolina suffered 36–100 and 5–34 per cent. mortality, respectively, after dusting, and it is concluded that considerable resistance to rotenone occurs in *E. varivestis* in the North Carolina area and that it is inherited and not a reflection of climatic or other differences [*cf. R.A.E.*, A **41** 368]. Other materials have proved effective [*cf.* **42** 167] and are being recommended in place of rotenone.

Holmes (E.). **Practical Plant Protection.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., xii + 252 pp., frontis., 4 pls., 13 refs. London, Constable & Co., Ltd., 1955. Price 15*s*.

This handbook for growers on the protection of horticultural and agricultural crops in Britain from weeds, insect and other animal pests, and virus and other diseases is concerned almost entirely with chemical measures. It includes general information on the different types and formulations of materials used in pest control, the factors to be considered when determining methods of application, the precautions necessary when handling

the materials, and their effect on beneficial insects and other invertebrates and on wild life. Measures against individual injurious insects and mites, cited under their popular names, with notes on their appearance and bionomics and the damage caused by them, are given in three chapters dealing respectively with arable and grassland crops, fruit and hops, and market-garden and glasshouse crops, and information on the symptoms, spread and control of several insect-transmitted virus diseases is given in another chapter. A short account of the official approval scheme for preparations containing crop-protection materials and a brief discussion of the advantages and disadvantages of the application of control measures by commercial contractors are also included.

Häfliger (E.). **Das Auswahlvermögen der Kirschenfliege bei der Eiablage. (Eine statistische Studie.)** [The selective Ability of *Rhagoletis cerasi* during Oviposition. (A statistical Study.)]—*Mitt. schweiz. ent. Ges.* **26** pt. 4 pp. 258–264, 2 graphs, 4 refs. Berne, 1953.

Oviposition punctures made in several thousand cherries by females of *Rhagoletis cerasi* (L.) were counted in the course of experiments on the control of this fruit-fly in Switzerland [*R.A.E.*, A **43** 31], and statistical treatment of the results indicated that the number of punctures per fruit does not rise above unity until the percentage of fruits punctured exceeds about 50. Thus, of the first 50 punctures made in 100 cherries, only two were in the same fruit, and the same result was obtained with 300 punctures in 1,000 cherries. It is concluded that females about to oviposit select fruits that have not already been punctured, but that when these become less numerous than those already infested, punctures are made at random. The author refers to previous observations [**26** 300] in which females about to oviposit were seen to investigate the fruits for 15–30 seconds and to trail their ovipositors over them at intervals, and concludes that this latter process renders the fruits distinguishable by females subsequently alighting on them.

Vogel (W.) & Ilić (B.). **Der Einfluss der Temperatur bei der Verpuppung der Engerlinge von** *Melolontha vulgaris* **F.** [The Influence of Temperature on the pupal Stage of *M. melolontha*.]—*Mitt. schweiz. ent. Ges.* **26** pt. 4 pp. 265–276, 5 figs., 11 refs. Berne, 1953.

The authors review the literature on the influence of temperature on the larval and pupal stages of *Melolontha* spp. [*R.A.E.*, A **27** 606; **31** 450; **43** 163] and give the results of laboratory experiments in 1952–53 on *M. melolontha* (L.) (*vulgaris* F.) and of field observations at various altitudes in Switzerland in 1948–53. Full-fed larvae placed on soil in loosely filled glass cylinders migrated downwards and pupated when kept at 18–25°C. [64·4–77°F.], remained just below the surface at 12°C. [53·6°F.] and descended but entered hibernation at 7°C. [44·6°F.]. The depth at which pupal cells were formed varied with the consistency of the soil. At 18°C., larvae descended for an average of only 2·8 inches in tightly packed soil and to the bottom of the cylinder in very loosely packed soil, while in cylinders tightly filled but having a 4·5-inch layer of loose consistency at the top, the pupal cells were formed at the bottom of the latter. In a test in which prepupae in their cells were kept at various constant temperatures, none entered the pupal stage at 7°C., few did so at 12°C., and those that pupated at over 30°C. [86°F.] were unable to develop normally. The optimum was found to lie at 22°C. [71·6°F.]. The prepupal stage, reckoned from the beginning of the downwards movement of the larvae, was found to last

three weeks at 22°C. and six weeks at 15°C. [59°F.], and to be so prolonged at 12°C. as to render pupation impossible in the field in autumn owing to the fall in temperature. The pupal stage lasted 4–5 weeks at 20–25°C. [68–77°F.], about eight weeks at 15°C. and 3–4 months at 12°C. The minimum temperature at which pupal development took place was between 5 and 10°C. [41 and 50°F.], and was thus lower than that for larval development.

Sample diggings were carried out in 1952–53 at Flims (3,250 ft. above sea-level), where adults had emerged in 1951, in a meadow on a southern slope and in a cultivated meadow less exposed to the sun. Sampling on 30th May 1952 in the first meadow showed that larvae were slightly less developed than in more low-lying areas, but further sampling on 11th July showed that this difference had been made good, all larvae having moulted to the third instar. In the second meadow, however, most larvae were still in the early second instar on this date and their average volume was only 0·4 cc. (the average volumes of individual larvae measured in alcohol in 1952–53 being 0·2, 0·9 and 2·3 cc. just before the first, second and third moult, respectively), while on 1st October, when larvae in the first meadow had reached an average volume of 2·3 cc., only a proportion of those in the second meadow had become full-fed, their sizes ranging from 0·9 to 2·4 cc. and averaging 1·7 cc. In spite of this difference in development, adults emerged at about the same time in 1953, emergence being in progress in both fields on 21st August and being completed by the beginning of October, but in the second meadow those larvae, representing about half the population, that were not full-fed hibernated again, whereas no third-instar larvae were found in the first meadow on 1st October. These results agreed with those obtained in 1952 at Alpnach (1,625 ft. above sea-level), where emergence was in progress on 20th August, and in 1950 at Wädenswil (at the same altitude), where emergence was completed on 30th September, thus showing that altitude has little effect on the date of emergence.

MAURIZIO (A.) & SCHENKER (P.). **Ist Nektar, nach Behandlung der Pflanzen mit Etilon und Diazinon, giftig für Bienen?** [Is Nectar rendered toxic to Bees by Treatment of Plants with Etilon and Diazinon?]—*Mitt. schweiz. ent. Ges.* **26** pt. 4 pp. 305–309, 4 refs. Berne, 1953.

In tests in Switzerland in 1953, borage (*Borago officinalis*) in flower was sprayed with 0·1 per cent. Etilon [20 per cent. parathion] or Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] and 79 hungry bees in 14 lots of 2–12 individuals were fed with the nectar at the rate of 0·04 cc. per bee and subsequently observed for mortality. When the nectar was taken from flowers that had been sprayed as buds 14, 30 or 38 hours previously, it caused no mortality in three days, but nectar from flowers open at the time of spraying six and 14 hours previously caused 75 and 87 per cent. mortality, respectively, over the same period, when the toxicant was Etilon, and 80 and 83 per cent., respectively, when it was Diazinon; when 24 hours elapsed between spraying and feeding, Diazinon caused no mortality and Etilon only 20 per cent., and this was reduced to 0 when the amount of nectar fed was halved. The unused portions of nectar were diluted with water and tested against the larvae of a mosquito (*Culex pipiens* L.). They proved highly toxic, even when the nectar was from flowers sprayed as buds 38 hours previously, Etilon causing 100 per cent. mortality in 12 hours in all tests, as compared with 75–100 per cent. for Diazinon, and having a more rapid effect. It is emphasised from these results that spraying in the evening provides no safeguard against loss of bees if the sprayed plants are in blossom.